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VARIATION IN ÆSTIVATION.

BY PROF. W. J. BEAL.

THE great variety of ways in which the sepals and petals of each species meet or overlap each other in the bud is often quite wonderful. In some cases, after examining many flowers, this is found to be true, even in certain species which have been described by some of our best authors as having the parts constantly arranged in a certain definite manner. Take, for example, the diagrams found in Hooker's Le Maout and Decaisne. It would seem as though the artist or the writers of the text, or both, had the idea that sepals and petals were arranged only in a few certain ways, as valvate, convolute, and imbricate in three modes, namely, spiral, opposite in twos, and quincuncial. It would appear by their diagrams that they had been remarkably successful in finding no other forms, or that they had kept throwing away all others as accidental or spurious until those only were found and used which corresponded to their ideal. These remarks will apply with equal force to several other botanical works.

In our best authors on botany, the diagrams showing the æstivation of the sepals of Cruciferæ all appear to be made as they look after the end of the flower-bud is cut off. This shows the sepal next to the axis and the one opposite to it overlapping each edge of the two lateral sepals. There is nothing in such a diagram to indicate that the tip of the anterior sepal overlaps the tip of the posterior. This is the case in all the buds of the several species which I have examined. In the diagrams of all works accessible to me, there is nothing to show that the tip of one of the side sepals overlaps the tip of the other. This overlapping of one lateral sepal was found in all cases examined where the tips were large enough for such purpose. Of fifteen buds of black mustard (*Brassica nigra*) examined, the sepals of

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ten, at their tips, showed the left lateral sepal overlapping the right; in the other five the right lateral sepal was outside the left one. In speaking of the right and left sepals of these flowers, I refer to them as they appear when holding the flower before us with the axis of inflorescence away from or beyond the flower. In the hedge-mustard (*Sisymbrium officinale*) the lateral sepals barely meet, making it impossible to tell which would overlap if they were longer. Of ten buds of *Nasturtium palustre*, seven had the right lateral sepal covering the left; and in three, the reverse was true. The æstivation of the petals of the three preceding species was not easy to determine with certainty, as the tips overlapped but very slightly or not at all.

In Chinese mustard, the æstivation of the sepals was variable, much the same as in the other species above noticed. Fifty flowers were carefully examined. I observed the position of each petal with reference to each other petal, and also its position with reference to the axis. Each of the four petals, or a corresponding petal in different flowers, was found outside; each was found inside. Bearing in mind, as I think we ought, the position of each petal with reference to the axis, I found that the petals of fifty flowers were placed in twelve different ways. In the first twelve examined, the petals were arranged in eight different ways, as follows. The dot indicates the position of the axis: —

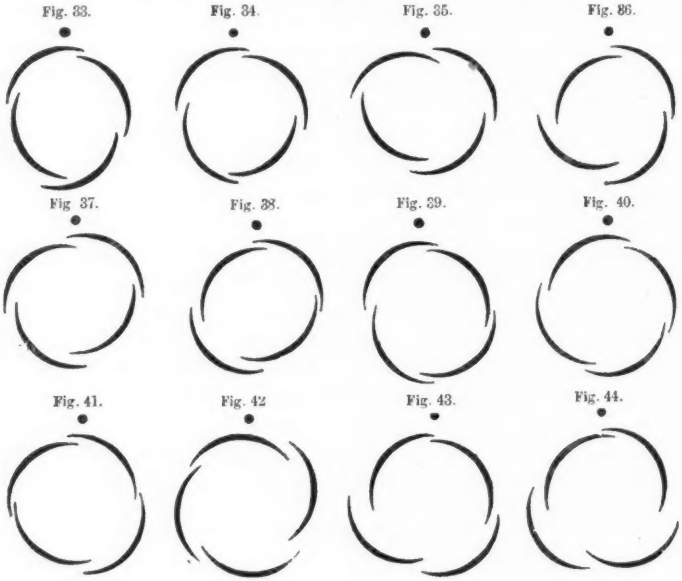


Fig. 45.

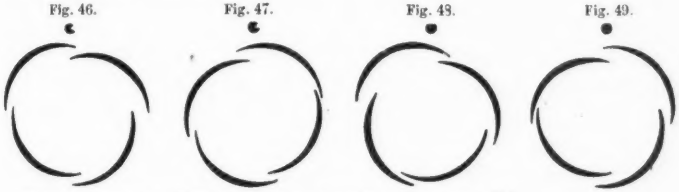
Thirteen were represented by Figure 33, six by Figure 34, five by Figure 35, four by Figure 36, three by Figure 37, three by Figure 38, three by Figure 39, three by Figure 40, three by Figure 41, two by Figure 42, two by Figure 43, two by Figure 44, and one by Figure 45.

With reference to the Cruciferæ, we find in volume i. of Gray's Genera of North America this sentence: "In æstivation, the petals are imbricated with usually one exterior, two half exterior and half interior, and the fourth wholly interior, or else they are regularly convolute." Le Maout and Decaisne say, "Petals variously imbricate in bud." Bentham and Hooker's Genera Plantarum says, "Petals convolute or imbricated with one exterior and the fourth interior." Neither of the above quotations expresses the arrangement for the order. The first comes the nearest because it is the most general of all.

Instead of twelve modes of arrangement for the petals of the fifty flowers mentioned, no doubt the variations would be considerably increased if the position of each petal were observed in its relation to each sepal.

Cleome integrifolia has four small sepals early open in the bud, variously imbricated. The four petals of one hundred flowers were arranged as follows: —

Fig. 46. Fig. 47. Fig. 48. Fig. 49.



Two species of Rosaceæ belonging to two different tribes were examined, namely, *Spiræa urticifolia* and *Agrimonia Eupatoria*. The Spiræa noticed has valvate sepals. The pedicels are too long to make it easy to discover which sepal is next to the axis. The tips of the petals overlap each other in the bud, making it quite easy to determine their relative position. Thirty-three buds were examined, showing fifteen different combinations or sorts of æstivation for the petals, without taking into consideration the position of each with reference to the axis. None were valvate nor regularly convolute, yet, I doubt not, they may be found.

Fig. 50.

Calling the outer petal number one, the next outside number two, and so on, I can show their position as follows by numbers which are here shown as we come to them passing around the flower to the right: —

In 2	flowers	the petals	formed a spiral to the right	1, 2, 3, 4, 5.
In 2	"	"	" " " left	1, 5, 4, 3, 2.
In 5	"	"	stood thus	1, 4, 5, 3, 2.
In 4	"	"	were quincuncial to right	1, 4, 2, 5, 3.
In 3	"	"	" " left	1, 3, 5, 2, 4.
In 3	"	"	"	1, 2, 4, 5, 3.
In 3	"	"	"	1, 3, 5, 4, 2.
In 2	"	"	"	1, 5, 4, 2, 3.
In 2	"	"	"	1, 3, 2, 5, 4.
In 1	flower	"	"	1, 2, 5, 4, 3.
In 1	"	"	"	1, 4, 3, 5, 2.
In 1	"	"	"	1, 2, 3, 5, 4.
In 1	"	"	"	1, 3, 4, 5, 2.
In 1	"	"	"	1, 5, 4, 3, 2.
In 1	"	the four petals	were	1, 4, 3, 2.
In 1	"	"	" "	1, 3, 4, 2.

In *Agrimonia* it was very easy to determine the relative position of each sepal and petal, and also the same with reference to the axis. Taking all these things into consideration, of sixteen buds examined closely only two were alike. Undoubtedly there were still many other variations. The five sepals in each case were quincuncial; in eight the spiral went to the right; in eight the spiral went to the left. In all cases observed the second sepal was next to the axis. Of the petals two were arranged in quincunx: with one of these the spiral turned to the right; with the other to the left. The petals of one were convolute; one spirally imbricated to the right, thus, 1, 2, 3, 4, 5. The rest were imbricated in various other ways.

Dr. Gray, Bentham and Hooker, and others speak of the petals of the *Onagraceæ* as convolute (contorta) in the bud. The majority of cultivated fuchsias are not convolute in æstivation.[1]

Of five hundred and seventy-nine buds of *Epilobium angustifolium* the petals of two hundred and eighty-five are convolute, turning to the left, and one hundred and fifty-four to the right. Fifty-three had a single spiral turning to the left, and fifty-three to the right. In twenty-three, two opposite petals covered both edges of the other two. In eight flowers one petal was exterior, one interior, and the other two petals of course were alike half-covered and half-covering. In three flowers one petal was outside and the other three were convolute.

[1] See note in American Naturalist, page 110, 1876.

Of thirty-eight buds of *Œnothera biennis* thirty were convolute to the right; three buds had one petal outside and the rest spirally turned to the right; two buds had one petal outside and the rest spirally turned to the left; two buds had one petal outside and its opposite one inside; one bud had one petal outside, the numbers running thus, 1, 3, 4, 2, to the right.

Of the order *Asclepiadaceæ* with reference to æstivation Dr. Lindley in Vegetable Kingdom says, "Æstivation of corolla imbricated, very seldom valvular." Dr. Gray in his Manual of Botany, last edition, says, "This order has commonly a valvate corolla which separates it from *Apocynaceæ* which has a convolute corolla." In the *American Journal of Science*, November, 1875, Dr. Gray says, "The type of the latter [*Asclepias*], and the common disposition when the parts are five, is with two pieces exterior, the third exterior by one edge and interior by the other, and two wholly interior." In other words, the petals are quincuncially arranged, the same as alternate leaves on the stem of a cherry-tree. Le Maout and Decaisne say, "Corolla usually contorted." Robert Brown, who gave especial attention to this order, says, "Æstivation of corolla imbricated, rarely valvate."

My first supposition was that I had examined a lot of exceptions to the general rule as stated by such good authority as Gray, especially as it is given as a distinctive mark to separate two related orders. On examining the other authors, I venture to give the results of the number of buds and the name of the species examined.

At the first glance, the corolla of *Asclepias* and *Acerates* seem to be valvate in the bud, but on looking closer, all I have seen are unmistakably convolute.

The petals of	thirty	buds of	*Asclepias*	*incarnata*	were	convolute	to right.
"	five	"	"	*variegata*	"	"	"
"	five	"	"	*tuberosa*	"	"	"
"	five	"	"	*purpurascens*	"	"	"
"	five	"	"	*phytolaccoides*	"	"	"
"	five	"	"	*Cornuti*	"	"	"
"	seven	"	"	*verticillata*	"	"	"
"	five	"	*Acerates*	*viridiflora*	"	"	"

The results, it will be seen, correspond with the account of Le Maout and Decaisne. Probably, Dr. Gray bases his description on other species than those to which I have referred.

In the order *Apocynaceæ*, of forty-three buds of *Apocynum androsæmifolium*, I found the petals all convolute to the right. Five buds of *A. cannabinum* were the same. In nine buds of the former, the sepals were quincuncial to the right, in five buds

quincuncial to the left. The other buds of that species were not observed. In the latter (*A. cannabinum*) four buds showed the sepals quincuncial to the left, and one to the right.

It will be observed that the æstivation of *Asclepias* and *Apocynum* are the same, at least so far as the specimens examined are concerned.

In the *Rubiaceæ*, of one hundred and fifty buds of *Cephalanthus* I found that eighteen were convolute, thirteen to the right, three to the left. In Genera Plantarum of Bentham and Hooker, in the tribe containing this species the text says, "Petals never contorted" Keeping in mind the position of all the petals as they stand with reference to each other and to the axis, and noticing the direction of the spirals, I found the petals of thirty-seven buds arranged in twenty-three different modes.

Each of the four petals was found to be outside, each inside, and each occupying either of the intermediate positions.

If we disregard the direction of the spiral and the position of the axis, these twenty-three modes are reduced to six modes.

In the same order, one hundred buds of *Galium asprellum* were all valvate.

Malvaceæ: In four hundred and thirty-three buds of *Malva rotundifolia*, two hundred and one petals were convolute to the right, two hundred and four to the left, fifteen quincuncial, and thirteen as in Figure 31. Lindley and Gray speak of the petals of this genus as convolute.

Fig. 31.

Fig. 32.

Tiliaceæ. In one hundred and seven buds of *Tilia Americana*, fifty-nine were quincuncial, turning to the left, twenty-four to the right, thirteen as in Figure 32; eight had one outside, and then the rest turned spirally to the right. Three were convolute to the left.

Oxalis stricta. Of nineteen buds, ten had the sepals quincuncial to the right, nine to the left. In twelve of these buds the petals were convolute to the right, in five to the left, in one spirally to the right, in one a still different mode.

In *Scrophularia nodosa*, the sepals are imbricated in various

modes and some are convolute. In buds of the irregular corolla, the two upper lobes cover the others. In twelve out of nineteen buds, the left lobe of the two outer lobes was outside; in seven the right lobe was outside. It is not easy to determine which is number three and which number four, both covering number five. Of over one hundred flowers of *Phlox Drummondii*, all had the lobes of the corolla convolute to the right. By cultivation and selection for some years, we have numerous permanent varieties or races showing a great variety in color, size, etc., but the æstivation shows no signs of change. I found in one hundred buds of perennial phlox the lobes of the corolla were all convolute to the right. Of over one hundred flower-buds of *Lobelia cardinalis* the lobes of the corolla were all valvate.

From the foregoing examples, I judge that enough attention has not heretofore been given to some of the forms of æstivation which have been thought uncommon. Each sepal and petal should be observed with reference to each other sepal and petal and the axis or bract; also the direction of the whorls or spirals, whether to the right or to the left. The tips of the flower-buds should not be cut off before observing them for diagram or description. Some species are quite constant as to mode, but vary in direction of spirals; others are constant in mode and in direction; others vary as to which sepal or petal is outside the rest. I have introduced no new names to express some of these modes of æstivation, nor have I used all those which others have proposed. In some cases I have preferred to number the outer sepal or petal one, the next within two, and so on till all are numbered. Then begin with number one and place the numbers in a horizontal row as they occur, passing always to the right as the flower is held before the observer. This mode would be of much greater value if we could always tell with ease which sepal or petal was next to the axis or opposite to it. Many authors have copied errors from each other. These errors have, doubtless, many of them been made, authors giving general or definite rules after examining only a few specimens.

As æstivation varies so much where it has been thought so constant, often even in the flowers on the same plant, it seems to me there has been too much stress placed upon certain modes; that it renders of less value the efforts of Jussieu and others to explain or harmonize the quincuncial with other kinds of æstivation. Perhaps we have placed too little stress upon some trivial circumstance or accident in deciding the mode of æstivation in any particular flower.

STONE IMPLEMENTS AND ORNAMENTS FROM THE RUINS OF COLORADO, UTAH, AND ARIZONA.

BY EDWIN A. BARBER.

IN my two preceding papers relative to the Ancient Pueblos of the Pacific slope of the United States, the first in the August number of The Naturalist and the second in the December issue for 1876, I have described some of the pottery and rock etchings of an exceedingly old American race. I shall strive to convey some idea, in this paper, of the tools which were employed by the same people in the manufacture of articles and in the erection of their stone houses. Some of the specimens herein figured I believe to be unique, but this cannot be ascertained to a certainty without examining every collection of western antiquities.

Stone implements and utensils are so numerous throughout the section of country formerly occupied by the Ancient Pueblos, that for the sake of convenience in describing them I will separate them into two divisions, calling them objects of warlike or peaceful vocations. Thus we have —

Weapons:

Arrowheads (of war[1] and the chase).
Spear or lance heads and darts.
Battle-axes or tomahawks.
Arrow polishers or straighteners.

Implements:

Hammers and Mauls.
Axes.
Knives.
Saws and chisels.
Awls, "rimmers" or borers.
Skin scrapers, or "fleshers."
Mortars and pestles.
Millstones (*metates*) and grinders.
Pierced pottery and stones for drawing out sinew (gauges).
Meat pounders.

Because it is an indisputable fact that great battles have been

[1] The greater number of the war arrows, I think, are undoubtedly of Ute origin, having been projected into the midst of the ancient towns, but some, at least, are the productions of the *besieged*, although they were eminently a peaceful people. We would not expect to discover these weapons of the Pueblo race, however, immediately under the walls of their own buildings, but rather further out on the plains. The majority of our specimens were found in the close neighborhood of the mural remains.

fought here, we would expect to discover large quantities of the utensils of war, and indeed we find this to be the case, as they abound in the vicinity of all of the greater ruins and many of the lesser.

(Fig. 51.) Natural Size.

The arrowheads are particularly noticeable on account of their delicacy, perfection, symmetry, diminutiveness (see Figure 51), and exquisite coloring.

They surpass anything of the kind ever discovered in any other portion of the United States. In a single locality is frequently found the greatest variety of forms, and two are seldom picked up of the same material. Figures 10 a, b, c, d, e, f, g, and h, Plate I., show some striking forms. We find them varying from less than half an inch in length to three inches. Sometimes we find a beautiful, transparent, amber-colored chalcedony specimen, while our next discovery may be a delicately fashioned point of obsidian. Here we discover a flesh-colored arrowhead made of agatized wood, while there we see another of a light pea-green tint. Red-jasper specimens seem to predominate, however, or are at least as numerous as those of flint, of which we find every shade of color. According to form, the arrowheads of this country may be classified into nine divisions, as follows: —

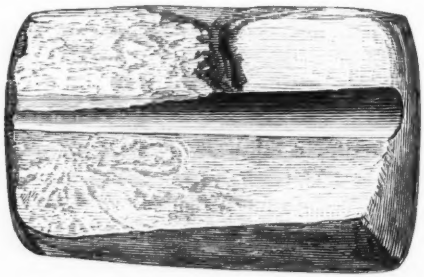
(1.) Those which are *leaf-shaped;* (2), those which are *triangular;* (3), those which are *indented at the base;* (4), those which are *stemmed;* (5), those which are *barbed;* (6), those which are *beveled;* (7), those which are *diamond-shaped;* (8), those which are *awl-shaped;* and (9), those having the shape of a serpent's head. Of course these forms are subject to modification, and often one runs into another.

The materials are agate, jasper, chalcedony, flint, carnelian, quartz, sandstone, obsidian, or silicified and agatized wood. Among the relics of battles the barbed heads are the most common, while the leaf-shaped varieties occur more numerously at a distance from the ruins on the plains, where they have been employed in the slaying of game.

It will be immediately seen why this distinction in the selection of missiles was made. The leaf-shaped or diamond heads could be readily withdrawn from the bodies of animals and used again, while the shaft of the barbed varieties could not be extracted from the body of a human victim without leaving the point in the flesh to produce inflammation and probably death. The larger sizes may have been used on the points of lances or

spears, as they are too clumsy and heavy to have been employed in conjunction with the bow.

The smaller varieties of axes may have been used as tomahawks in war. Under the head of weapons I have placed the *arrow-straighteners* or polishers, although they may more properly be classed with the second division, as they were not used either for offense or defense, but only for polishing or straightening the wooden shafts of arrows.[1] We found but one specimen, or rather the *half* of one. This instrument originally consisted of two flat stones about three inches long, two inches wide, and half or three quarters of an inch thick. These were ground smooth on the faces so as to fit accurately together, and through one end of the united halves was bored a circular hole, penetrating to the other end. Half of this orifice lay in each stone. The wooden shaft was laid horizontally in one stone and the other fitted over, and by drawing the stick in and out it was polished and straightened. (See Figure 52.) This specimen is made of a coarse, pink sandstone.



(Fig. 52.) ARROW-STRAIGHTENER. (Natural Size.)

The latter class, or *household implements*, though not so numerous, we found more widely distributed than the former. These were scattered through all of the ruins, the majority crudely made, but some of them smoothly polished and ground to a cutting edge.

The edges of the latter class of stone axes were kept in order by abrasion or by rubbing them down on stone whenever a notch was accidentally made. Sometimes this laborious process occupied days, and a single careless blow with the axe might destroy the results of many hours of labor. I noticed along the sloping surface of the narrow ledge of sandstone on which was built the *Casa del Èco*, a ruin on the San Juan, several rounded depres-

[1] For an illustration of a similar tool refer to Evans's Ancient Stone Implements of Great Britain, page 241.

sions, a couple of inches deep in the centre, about four inches wide throughout, and perhaps six or eight in length, which were undoubtedly the results of this artificial process of attrition. Here, I am satisfied, beneath the walls of the houses the ancient laborers stepped out to sharpen their awkward stone tools.

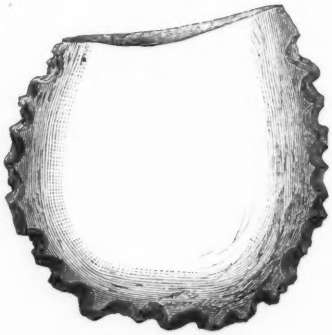
In Plate I. may be seen a peculiar form of axe (Figure 5). It has seen much service, and is furnished with a groove for the attachment of a handle. This specimen was found at a ruin near Abiquiu, N. M., and is made of a light-colored chloritic schist. It is three inches in length. A number of forms of hammers and mauls were discovered, varying in weight from a few ounces to twenty-five pounds. Figure 53 shows an unusual form of a stone hammer obtained in the Moqui towns of Arizona. The man from whom I purchased it informed me that it had been handed down from generation to generation, and had been used by the old fathers of the tribe long before iron was introduced among them by the whites. It is made of a hard, greenish porphyritic rock containing iron, which is seen streaking the sides of the implement. The stone is similar to the *verde antique* of the ancients.

(Fig. 53.) HAMMER OF PORPHYRY.

Great mauls weighing twenty pounds and over were used by the Ancient Pueblos, though for what purpose it is difficult to imagine; they must have required more than one pair of hands to wield them. These were usually made of compact sandstone, and were cylindrical, with the groove for the handle extending around the circumference near one end. The striking end was frequently terminated conically. There was also the flat, water-washed cobble of the river, which was similar to many of the axes, excepting that it had not been ground to an edge, but was used in a blunt state for pounding. Some of the hammers were ovoid, with the groove extending around the centre, so that either side could be used at will. Several beautifully shaped and polished fleshers, or skin scrapers, were picked up by the party along the San Juan River. These are about six or eight inches in length, with the broader end sharpened. They are made of smooth, fine-grained stones, such as jasper or silicified wood, although I found a portion of one which was a chocolate-colored slate. Mr. Holmes, in the Mancos Cañon, observed the end of one protruding from the floor of a ruin, and upon drawing it

from the soil found it to be a very perfect specimen, but stained black over the portion which had been buried.[1] The only use to which such tools could have been devoted was the tanning, cutting, or scraping of hides and skins. Another curious form of the same may be seen in Figure 54, which is probably unique. This is made of a bright-yellow jasper; it is ground flat and

(Fig 54.) FLESHER OF JASPER.



(Fig. 55.)

smooth on each side, and is scarcely a third of an inch thick. The end of the handle is wanting. I can conceive of no use for which this spatulate instrument could have been intended except skin-dressing. The edges are blunt and rounded, and it *may* have been employed in culinary operations as a spoon or ladle.

Numerous serrated implements were picked up among the *débris* of the ruins, of different sizes and forms, which were evidently intended for sawing. The fragments of some indicated that the entire instrument had been several inches in length and an inch or so broad. One, however (Figure 55), was a circular stone of a bright-green color, in which the entire circumference (with the exception of a small arc) had been toothed or chipped. This was probably used in the same manner as the straight saws, being held between the finger and thumb.

Chisels, awls, borers and rimmers occur in abundance. The chisels or pointed tools were probably used in chipping out hieroglyphics. The awls, borers, and rimmers were employed in perforating skins, wood, stone, etc.

Among the pottery and pendants may be seen holes made by

[1] See Figure 3, Plate I.

these instruments. One opening of the orifice is small, while the other is larger and funnel-shaped, revealing concentric rings, showing that the tool with which they had been bored tapered gradually to a point. On account of the delicate nature of these, it is seldom that a perfect one can be found, but Figure 56 represents an unusually delicate specimen picked up on the Rio de Chelly. It is shaped like a horseshoe nail and chipped from a perfectly white stone.

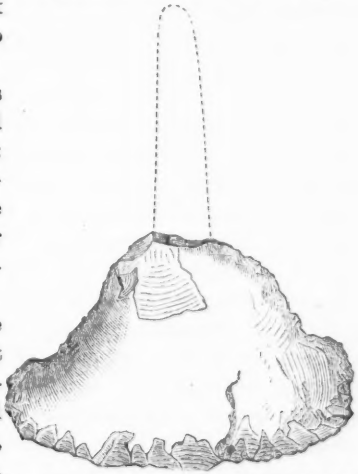
(Fig. 56.)

Stone mortars are rare in a state of entirety, yet we found many fragments scattered over the plains and through the cañons. The prevailing material seems to have been sandstone; pestles are very rarely seen. However, in the Moqui village, I observed several stone mortars, some eight or ten inches in diameter, with their accompanying pestles, which had been placed on the house tops, and I was told that they had not been in use for many years, having descended with many old stone implements from the forefathers of the tribe.

One of the most common objects to be found in and about the crumbling buildings is the millstone, or *metate*, and with it the corn grinder. Lieutenant Emory says of the ancient remains along the Gila River: "The implement for grinding corn and the broken pottery were the only vestiges of the mechanical arts which we saw amongst the ruins, with the exception of a few ornaments, principally immense well-turned beads, the size of a hen's egg." A good specimen of a grinder may be seen in Figure 4, Plate I.: it is made of black cellular basalt, found near Ojo Caliente, N. M.

The great numbers of pieces of perforated pottery and small stones were used in two ways: some were intended for ornamenting the person, while others were doubtless used for drawing out sinew for bow-strings and thread.

Other implements were discovered whose uses have not been determined, such as Figure 57. I picked up several polished stones of a pink color, ground down flat on each side. These were a couple of inches



(Fig 57.) STONE IMPLEMENT WITH SHARP EDGE.

in length and an inch in width, but whether designed for some ornamental purpose or whether used as implements of some kind, I am unable to say. Figure 1, Plate I., is a specimen of basket weaving found in one of the ruins of the Mancos, but I am inclined to think that it is not of very ancient workmanship, but was most probably carried there by some roving Indian who belonged to a more recent tribe. Yet it is not improbable that this had been woven centuries ago, for it is made of a species of rush (*Scirpus validus*) which occurs abundantly on the banks of the stream, and this kind of vegetable matter, containing, as it does, a considerable amount of silica, might remain perfect in sheltered locations for an indefinite period.

Figure 2, Plate I., illustrates a bundle of sticks which was found buried beneath a pile of rubbish in a cliff house of the same cañon. These sticks may have been used in some game. Such objects are employed at the present day by several Indian tribes. The Utes use them in gambling, each one counting a unit. As they are won they are stuck in the ground in front of the player, and he who succeeds in winning all the sticks gains the stakes. These pieces of wood have been sharpened at one end by rubbing on stones. Mr. Holmes, who discovered them, says, "The bit of cord with which they are tied is made of a flax-like fibre carefully twisted and wrapped with coarse strips of Yucca bark; beside this a number of short pieces of rope of different sizes were found, that for beauty and strength would do credit to any people. The fibre is a little coarser and lighter than flax, and was probably obtained from a species of Yucca which grows everywhere in the Southwest."

Among the personal adornments of most aboriginal tribes of men are found many varieties of beads which have been cut or ground from wood, bone, horn, stone, claws, and teeth of animals, or shells. Those made of various species of the latter predominate, the marine shells, such as the *Busycon*, *Marginella*, *Oliva*, *Fasciolaria*, and many other genera (usually *univalves*) being the most common. The prehistoric people of Arizona, New Mexico, Utah, and Colorado employed, in the decoration of their persons, at least *two* genera, of which several species were discovered by the photographic division of Hayden's United States Geological Survey.

All the bead ornaments found in this section of the West may be classed under four heads: —

I. Shells.

II. Earthen-ware beads.
III. Turquoises.
IV. Pendants.
(A, of stone; B, of pottery.)

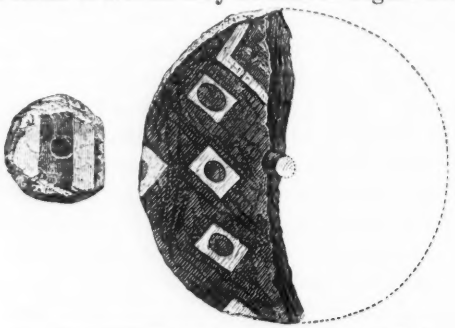
The marine shells which were converted into beads by the ancient tribes, so far as has been ascertained by the investigations of the United States Geological Survey, during the summer of 1875, were the *Oliva* and (possibly) the *Busycon*, or *Murex*. Of the former genus we were so fortunate as to discover at least one species. Figure 7, Plate I., represents a specimen of the *Oliva biplicata* (probably), although the shell[1] is so weather worn that the specific characteristics are almost entirely obliterated. Still, it strongly resembles this species of the Pacific coast, and is very likely the same. This size, however, was not so common as a larger variety which is, in all likelihood, a more fully developed representative of the same species. The first samples of these shell beads were taken from the site of an old ruin where they had been lying for many centuries, until they had become entirely decomposed. Through Eastern Utah and south into Arizona many Olivas were found scattered through the *débris* of crumbling walls and broken pottery. The perforation has been effected by grinding down the apex so that a thong would pass through the shell lengthwise. Of the genus *Busycon*, or *Murex*, was found but one doubtful example. The beads made from this were of two sizes and usually white. The smaller variety was flat on both sides, or slightly convex on one side and concave on the other (Figure 58), as thin as a wafer, and the circumference of an ordinary pea. In the centre a neatly bored hole enabled the owner to string them together in the form of a necklace. The larger variety was about the circumference of an average buck shot. Such beads were evidently held in great esteem by the wearers, and among the ruins they are extremely rare, only a few specimens having been found. Captain John Moss, of Parrott City, Col., says that these beads are valued highly by the present Navajo Indians to the south, a small string, when such can be found, bringing in exchange a good horse. The Navajoes are constantly grubbing about the old buildings and adjacent graves in search of these trinkets; this accounts in some measure for their great scarcity among the ruins to-day. They were undoubtedly obtained by the ancients from other tribes who brought them, or at least the

(Fig. 58.)

[1] It may be *Olivella gracilis*.

shells from which they were fashioned, from the Pacific coast. We know that these ruins extend as far west as the junction of the San Juan and Colorado rivers, so that communication between the tribe in question and others situated along the Pacific Ocean or Gulf of California was rendered easy. Don Jose Cortez, writing of the tribes near the Colorado, in 1799, speaks of "the white beads they get on the shores of the Gulf of California."

Of the second class of bead ornaments, many are found among the heaps of ancient pottery which surround the majority of the old ruined buildings. A small piece of pottery, generally of the best glazed and painted ware, is selected, and the edges ground down into a circular or rectangular form varying in size from a third of an inch to two inches in diameter, or from a half inch to an inch and a half in length. The circular specimens have perforations in the centre, while the square or rectangular varieties have holes near one end. These latter may be classed with No. IV. Some forms of No. II. may be seen in Figure 59.[1]



(Fig. 59.) ANCIENT INDIAN POTTERY. (Natural Size.)

The third division is represented by but a single specimen, which was picked up during the month of August, 1875, in the Cañon of the Montezuma, in Utah. It is simply a piece of turquoise flattened and polished on both sides, and is undoubtedly half of a small plate or bead, as is demonstrated by the orifice, at which place it has been divided. The hole was evidently bored by a stone rimmer, as the opening on the upper surface is much greater in diameter than that on the under. This interesting relic measures about a third of an inch across its greatest diameter. Turquoises, the "*chalchihuitls*" of the Aztecs, were obtained from the Los Cerillos Mountains, in New Mexico, southeast of Santa Fé. Here is a quarry which was worked before the arrival of the

[1] The largest of these may have been designed for spindle whorls.

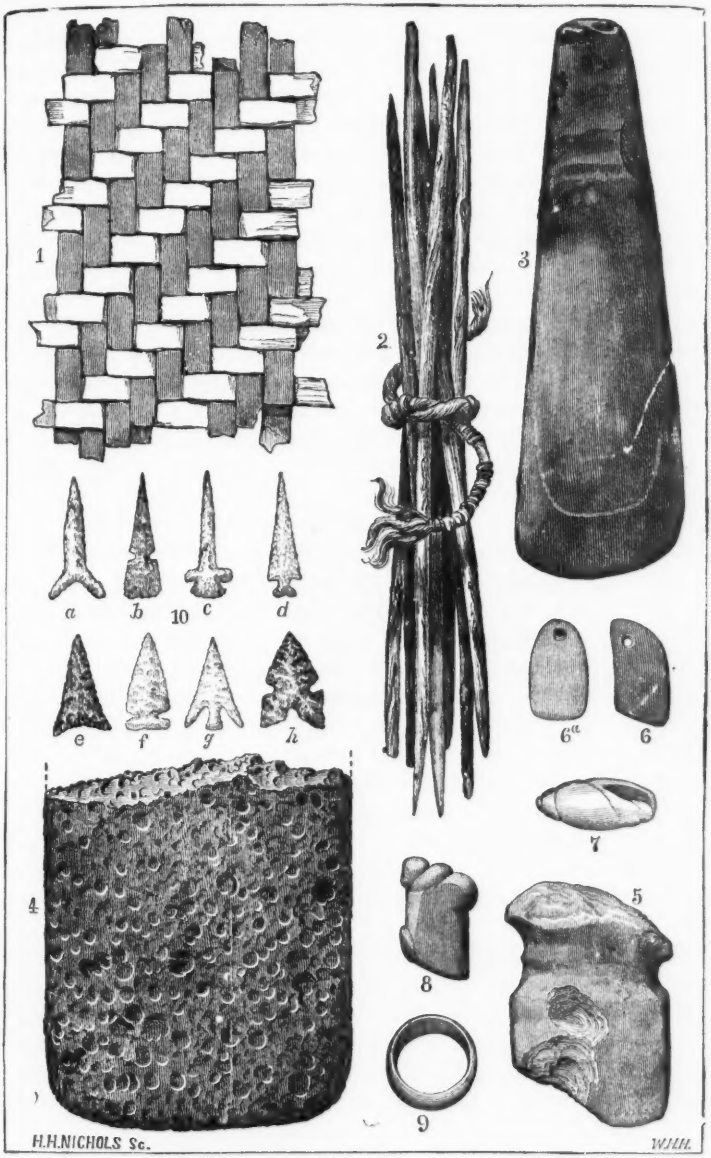


PLATE I.

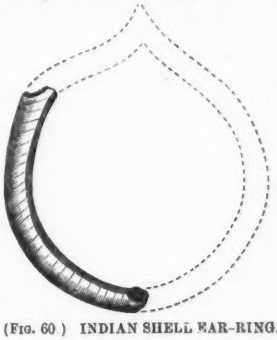
Spaniards in the country, and it was here, undoubtedly, that the ancient "cliff-dwellers" obtained their turquoise. Here, probably, their descendants, the Moquis, Pueblos, and Zuñis, procured the turquoises mentioned by the Reverend Father Friar Marco de Niça in 1539, and by Francisco Vasquez de Coronado in his account of his visit to these people in 1540. Marco de Niça wrote: "They have emeralds [1] and other jewels, although they esteem none so much as turquoises, wherewith they adorn the walls of the porches of their houses and their apparel and vessels, and they use them instead of money through all the country."

The fourth and last class of bead ornaments consists of all those trinkets made usually of stone or silicified wood, but occasionally of pieces of pottery which were employed in decorating ear-rings or necklaces. These are usually flat, neatly polished, rectangular pieces, with the aperture in one end. They vary from half an inch to two inches in length, the width being usually about two thirds of the length, and from one sixteenth to one eighth of an inch in thickness. The form graduates from the rectangular to the elliptical, as the corners are more or less rounded. Figures 6 and 6a, Plate I., represent two of these ornaments, an inch and a quarter in length. These were suspended either from circular ear-drops, made mostly of shells, or from the front centre of necklaces, and in some cases may have been worn at the nose. Some such ornaments as these are still employed among the Yampais, Pimas, Mojaves, Moquis, Pueblos, and Zuñis of Arizona and New Mexico.* This style of perforated ornament was the commonest, and the specimens are the most abundant of all the varieties which may be classed among the *bead work* of the ancient people of the West. They include all such objects as pendants, "gorgets," ear-drops, and nose ornaments, usually made from silicified wood, though occasionally from a white, fine-grained limestone.

The shell ear-rings were manufactured with much labor, and used by the same people. One single fragmentary specimen was discovered by the party, but it is sufficient to show its use, and was probably a representative of an ordinary form. (See Figure 60.) The circlet was cut from a whorl of a marine shell, most likely the *Murex*. As shown by the arc of the circumference of the specimen, itwas originally about one and five eighths inches in its outer diameter. To such attachments as this the pendants

[1] Chrysolite, probably.

of Class IV. were suspended. Another, similar to this but larger, which was found at the Casa Grande (Chichilticale), on Rio Gila, is figured by Lieut. A. W. Whipple in his report. One specimen of a finger ornament was found by Mr. Holmes's party. It represents a *stone* ring about five eighths of an inch in diameter, made of hard, gray slate. This may be seen in Figure 9, Plate I.



(Fig. 60.) INDIAN SHELL EAR-RING.

The perforations in the pendants are drilled, some of them from each side, meeting at the centre, while in others the boring has been done entirely from one side. In the majority of cases the orifice is funnel-shaped, but occasionally we meet with a piece of pottery in which the perforation is of the same diameter throughout. This neat puncturing must have been accomplished with superior stone awls or borers. In some specimens of pendants the hole has been started and sunk half way, but not completed. Figure 61 illustrates a very pretty charm or chain ornament (possibly a *totem*) made of a white stone. It represents an animal of some kind, is cylindrical, and was probably worn at the neck; it may have been a sinker. This is the only object of this kind found throughout this country, with the exception of a carved figure (Plate I., Figure 8). Several pieces of white wampum were also picked up near the mouth of the Rio de Chelly, but they were not drilled hollow. They resembled pieces of solid pipe-stem about an inch in length, and had either been cut from a thick shell or were fashioned from a white stone.

(Fig. 61.) AMULET OR PENDANT.

We see, then, that the ancient Pueblos devoted much time and labor to the production of objects for the decoration of the person, and in this respect they displayed much ingenuity, and their surviving ornaments reveal to us some degree of the vanity with which they were endowed.

GLIMPSES OF MIND IN BIRDS.

BY DR. CHARLES C. ABBOTT.

ON the morning of the 20th of December, 1876, a large flock of small sparrows was seen to pass over my house and settle down in the old oaks immediately beyond. There they remained and chattered for fully an hour, when with one accord they all took flight and sped on their way southward. There was no need of destroying the lives of any of these joyous songsters, for they were so very tame that they were easily recognized while busily flitting through the then ice-covered twigs of the oaks. They were the common tree-sparrows (*Spizella monticola*). I was so much struck with the peculiarity of their movements, in the dual circumstance of migrating in company and in their close proximity while on the wing, — two conditions I had never before noticed with reference to this sparrow, — that I started out for a day in the field, to see if other birds were to be found migrating by day, as though endeavoring to escape the severity of the weather, which was unusual.

I wandered along a wooded hill-side having a southern outlook, and from thence to a narrow strip of marshy meadow beyond. An occasional meadow-lark, a single song-sparrow, and the grass-finch (*Poöcætes gramineus*), ever at home, were the only birds to be seen. After a three hours' ramble I turned my steps homeward. It was scarcely two hours before sunset, and while I lingered under the grand old oaks and listened to the occasional chirp of some unseen and distant sparrow, a loud, whirring sound and constant chirping caused me to look up. In the same oaks was another flock, but of very different birds. They, too, were recognized at a glance. They were the purple finch (*Carpodacus purpureus*). They lingered for many minutes, when with one accord, though I could not determine upon what signal, they, too, took flight, but in a westerly direction and in the face of a bitterly cold wind that was just freshening into a gale.

The particular actions of these two flocks of widely differing species of finches were of much interest to me, and have suggested some thoughts as to the purport of their evidently migratory movements.

It is not an unusual occurrence for any one species of our birds suddenly to quit a neighborhood where they may have been in

numbers for many weeks, and after a longer or shorter absence as suddenly to return to their accustomed haunts. More particularly is this the case with our winter residents. It is generally supposed that these semi-migratory movements are in consequence of meteorological conditions, the birds having the power to foretell a change by recognizing it through alterations in inanimate nature, not appreciable by man, or more probably by electric conditions acting directly upon them, on the same principle that a gouty big toe is an excellent barometer. Granting that these sudden departures from a given neighborhood by any species of birds or by the birds generally are caused by a meteorological influence, operating on each individual alike, would they not then go as individuals from the locality where the influence is felt to one better suited to them, during the prevalence of the obnoxious conditions? Every bird would then become a mere automaton, wafted to and fro at the mercy of the winds and clouds. While I do admit that the weather is the determining cause of the birds' movements, I am convinced that the influence is exerted in a somewhat different way. These temporary migrations are not made individually, but collectively, the birds maintaining a close association, their numbers not varying between the times of their departure and arrival. No meteorological influence could produce a flocking of any species, as represented in a given area, previous to forcing or at least inducing them to quit the neighborhood. Now, if we allow to birds exact geographical knowledge of a considerable extent of territory, then experience will have taught them, without doubt, that a ravine extending at right angles to the track of a storm is a proper shelter while the storm or "spell of severe weather" lasts; and the atmospheric conditions pending the change admonishing them, the scattered birds would depart thereto and arrive singly from every quarter, congregating for the first time when safely in the protecting ravine; but this is not found to be the case at all. They congregate wherever they may happen to be, and this necessitates an uttered signal, understood by them. Once collected they determine their route and depart in company. In December last, as I have related, I met with two such flocks of migrating birds. In thus associating they must derive either benefit or pleasure, if not both. If benefit, it must be that a mutual understanding exists among them; if pleasure, there must be an interchange of the impressions made upon one to the other. That it is an audible interchange we all know, for flocks of

mutes do not occur; that it is a varied expression of notes, peculiar to each species, is as well known; and so, judging these same birds from a human stand-point, they assuredly know themselves and understand each other, have definite expressions for certain conditions, have, in fact, the gift of language as the natural outcome of that power of thought which their methodical lives show they duly exercise.

The presence or absence of food in any given locality is also rightly supposed largely to influence the stay or departure of all birds, either resident or migratory; but let us take the instance of the roving purple finches I have referred to. In this case there was doubtless an abundance of food available for weeks in the little wood in which they tarried for so short a time. They certainly did not remain long enough to determine that point, and so gave evidence of a predetermined journey to some particular point, towards which they were moving when I chanced upon them. On these same oaks and about the hill-side generally, scores of times I have seen these finches often for days together, and consequently finding sufficient food. When I last saw them they were not seeking out better feeding grounds than those they had left, but a locality otherwise more suitable. If, then, there is in the character of these migratory movements even a trace of predetermination, does it not bear directly upon the question of the conveyance of impressions from one to the other? and if the sounds they utter are closely related to their movements, can we conceive of these as having any other significance than that of being the means by which they express their thoughts, — that their utterances are strictly a language? One can easily believe that an elaborate song is a pleasure to the little musician himself as well as all his hearers, and may be given, perhaps, with a wholly selfish intent; but not so can we explain away the endless chirps and twitters expressed during the ordinary routine of each day's existence.

Again, as bearing upon the subject of birds' flocking, together with their various "notes" or language, it is to be borne in mind that widely different species do not migrate together, but on the other hand, allied species and genera are thus associated, and there is a marked similarity in very many of the "calls" of these allied species, as well as identity in habits and preference for the same localities. And are not these facts, by the by, suggestive of the great probability that in the distant past the variations now existing in our widely different birds were far less in num-

ber, and that the influences exerted by endless external conditions have been in part the origin of the so-called species of to-day? But possibly speculation as to the origin of the specific variation in bird life is in vain; and coming back to the present, to see it as it is, we find far more that suggests laborious study than a life-time can accomplish; and that, too, without seeking for marked exhibitions of ingenuity on the part of the birds. Interesting as these are to the field naturalist, whenever met with, it is doubtful if such chance occurrences are really as instructive in one's endeavor to appreciate the mental endowments of birds as are their ordinary daily and seasonal acts.

And again, as indicative, I think, of the existence of a mind essentially the same as our own, is that love of company of their own kind, which is so marked a feature of bird life. Birds may be associated and influenced pleasantly by each other's presence without being "flocked," as we say of gregarious species. After nearly a score of years of out-door study in the woods and about the fields, through the marshes and over mountains, I am well satisfied that the bird is eminently a social creature. One need but watch the busy warblers as they wander from twig to twig of our elm-trees to note how humanly they act when two chance to meet face to face while passing around the large branches: a moment's halting, a cheery twitter, a still more emphatic adieu, perhaps their parting note, and they separate to continue their untiring search for insects.

Capture, if you have the heart to do so, a nest-building bird, and place it in a cage, near the site of its unfinished home. See with what painful curiosity its puzzled mate endeavors to comprehend the mishap, and fearless of the cage itself, with what close scrutiny it is examined, in hopes of finding some available crevice through which the captured bird may escape. Note with what care an abundance of food is brought to the prisoner, showing that the bird realizes some of the difficulties into which its mate has fallen. The utterances of both, too, are at this time worthy of the closest attention. They are not simply the sharp chirp of fear on the part of the captured bird, but a varied intonation, characteristically responded to by the bird at large; and one cannot fail to interpret it as an appeal for assistance. I have experimented in this cruel manner many times; and while the caged victim was confined, its mate proved faithful, and the character of every act under these peculiar circumstances, in connection with their utterances, confirmed my belief that their vocal

power has been evolved for the same ends and largely meets the same requirements that the power of language accomplishes for man.

Let us now view bird life from another stand-point. There are not a few indications to show that birds are not victims of predestination, such as some worthy people are unhappily deluded into supposing themselves to be, but, being quite free to choose, exercise not a little forethought, especially in spring, in predetermining their movements, in part, during the coming season. How else, for instance, can we explain such a fact as the abandonment of a partly constructed nest and rebuilding elsewhere, usually on the same tree? I have so closely watched orioles while building, that I am confident that a nest nearly finished was abandoned not from experience of its being of too easy access to enemies, but because subsequent thought suggested the possibility of such an occurrence, and therefore the change of position was decided upon. Such instances are quite common; and strangely enough these abandoned nests are not utilized in the manufacture of another, but are left, I believe, as a blind to the enemies, which now are happily but few, of this particular bird. In one case the delicate branches of a weeping-willow being found too slight for the weight of the nest when occupied, another branch some few inches distant — as nearly as I could determine, about a foot — was brought into use, as an additional support, by carefully interweaving a long string with the body of the nest, and then carrying it up and attaching it by a number of turns and a knot to the branch above. Thus secured, the nest sustained the weight of the young when fully grown and both the parent birds. The little warbling fly-catchers that build a semi-pensile nest in the fork of delicate twigs have been known to do precisely the same thing, especially when the cow-pen bird (*Molothrus pecoris*) burdens them with an egg that when hatched taxes severely the strength of their slightly built nest. Here we have forethought, for while the nest, in the case of the orioles, was sufficiently secure for the proper care of the eggs, and would sustain the additional weight of one bird, they knew that when the young were well grown and required the care of both parents in feeding them, then the nest must needs be stronger than they had originally made it. Can we consider it probable that the same idea of future insecurity occurred to both parent birds simultaneously? Yet they worked together in the addition made to it. Rather the idea, occurring to one, was com-

municated to the other, and the chirps and twitters of a whole afternoon were their sole means of communication. Here, have we not, without overstraining our imagination or at all taxing our credulity, a veritable glimpse of mind in birds? Further, is it not an indication of a high order of mental power? These birds were not simply pursuing the ordinary routine of nest-building, but actually carefully considered the future and its possible mishaps, and guarded intelligently against them.

The senseless persecution to which our common crow has been subjected by short-sighted farmers — for it is in reality a most valuable bird to the agriculturist — has rendered it exceedingly shy and cunning. This is well known to every one who has ever seen a crow, at least in our Middle States. While timidity has doubtless become hereditary in all our birds, and is increased in every individual through imitation of the parent birds, which themselves act not only from hereditary impulses, but from experience, on the other hand cunning is not necessarily an inherited trait, as it differs so greatly in individuals, but is an acquired one; and can we be mistaken in considering that this same cunning on the part of some is recognized by the masses, and being constantly associated, they naturally learn to defer to the better judgment of the superior birds. On the other hand, crows, as men, soon learn to realize their superiority over their fellows, if they possess any, and quickly assume the position of leaders. In some very similar way, I believe that crows have developed through their experience as persecuted creatures that power of organization — executive ability we call it in mankind — through which they are able to maintain their numbers and escape destruction. It may be urged that superior cunning ought likewise to have been evolved among our game birds, inasmuch as they have been far more persecuted, so that they too might have successfully baffled their tormentors and maintained their ground. I can but say that to some extent it probably has, but that they may have less active intellects, and their being so unintermittingly pursued has had a depressing effect; while on the part of crows, persecution has resulted in acceleration of the development of mental powers. Contact with man, it is easily seen, has sharpened the wits of many of the lower animals, to such an extent in some, that like the crow they can resist him; while others, like the great auk, perhaps through want of energy, have perished.

Birds are not naturally given to excesses in eating or drink-

ing, but now and then it happens among the berry and seed-eating species that they do not discriminate between wholesome and unhealthy food, and the result, very naturally, is sickness. I have known robins to be poisoned by eating belladonna berries, and sparrows to become "bewildered" by pecking at trash thrown from an apple-whisky distillery. These occurrences suggested a simple experiment with alcohol, and my victims were crows. While the ground was well covered with snow and the crows quite tame in consequence of the scarcity of food, I soaked some corn with alcohol and placed it where the birds readily found it. In a few minutes it was all devoured by four crows who, like Oliver Twist, were clamorous for more; but their clamor soon ceased. The ordinary intoxicating effects of alcohol soon began to show themselves, and stranger antics no silly parrot ever yet performed. They gave way at first to loud and rapid talking, loud even for a crow; then, after vain endeavors to fly away and subsequent ones to rest upon the topmost rail of a neighboring fence, they gave themselves up to the most ludicrous, subdued mutterings, and finally turned gracefully over, fell from the fence, and lying in uneasy positions upon the snow soon became entirely motionless, as profound slumber overcame them. The facts I desired I believe were obtained. The physiological effects of the alcohol proved to be the same as in man; and I am convinced that we have an indication here of what is in all probability the case, that their brains are at least so far like our own that the normal operations of the organ are, too, of identical character. Crows see with their eyes, they hear with their ears, and why deny that also they talk with their tongues and throats, and think with their brains? When we realize the full extent of the mental capabilities of birds, the mighty distance that ignorance has imagined lies between the brute creation and mankind becomes narrowed to a little space indeed. So, when we study mankind precisely as he is, and recall the semi-brutal state of prehistoric times, it is doing no violence to truth to see more of humanity in the less favored forms of life, and to admit that our own progress is still clogged by the traces of our former brute-like condition. Allied to the subject of intoxication is that of permanent insanity. Does a functional or organic disease of the brain ever occur in birds? Of course all reference is to birds in a state of nature. We are all familiar with instances of birds in confinement that have apparently died of grief from the loss of their mates. We have here a case of cerebral action

that cannot be explained, if to a bird's brain we only accord the operations of instinct. Grief has no more to do with instinct, pure and simple, than ordinary emotions have to do with the heart; and yet birds certainly do experience all the pains occasioned by grief, and when this becomes excessive, so as to cause death, then it has at least reached the border lands of insanity. I now ask, Do birds ever in their feral state pass quite beyond it? If not wrong in considering intoxication temporary insanity, then certainly birds are at times permanently insane.

It not unfrequently happens that birds are forced to take flight at night, when darkness only is visible, and are wounded or stunned by coming in violent contact with some resisting object. While such an accident usually proves fatal, it not always does so, although permanent cerebral injuries are received. I recall now an instance of a male quail coming with tremendous velocity against a window, literally cutting a passage for itself through the pane, and falling on the floor on the opposite side of the room. The bird was picked up for dead; but while being examined it revived, and the ill effects of the concussion partially passed away; but assuming that the bird was as mentally strong as its fellows before the accident, it was ever after not subject to occasional fits, as a cause of the mishap, but in fact permanently insane. While none of its movements were what one might expect of a quail in confinement, this one had a number of very crazy notions. The most noticeable peculiarity was that of whistling its ordinary call-note backwards, thus, "*White'*-bob," for Bob-*white'*. The intonation and accent were exactly reversed, and were at once noticed by every one who had ever heard a quail whistle. While very tame and gentle with the family, it readily recognized strangers as such, and if approached by them would strike at them with its claws, lying flat on its back, reminding one forcibly of a wounded hawk. Another very marked peculiarity of habit was that of chasing or appearing to chase its food, the bird evidently laboring under the impression that its food was alive and endeavoring to escape. It may be claimed that the passage through the pane of glass may have injured its eyesight, and so the apparent chase of its food was caused by disordered vision. This is met by the fact that in no other way did its vision appear to be affected, and it was tested in several ways; and again, the effects of the concussion would scarcely have caused also an alteration of its vocal organs, as though its larynx by the blow had been turned wrong end foremost.

Somewhat similar instances have occurred, where birds have been slightly wounded with fine shot. The wounds have entirely healed, the locomotive powers are all restored, and yet the bird is quite another creature, not only in its manner in confinement, but its desire for liberty, so strong in birds, has totally disappeared. The effects of the wounds have been to radically change the mental characteristics; yet, so far as determinable, every function of the body is in proper working order. If, then, it is unnatural in its ways, endeavoring to do many things to which it is not adapted, and which its wild associates never do, it is simply insane; and if insane, then there must be the essential elements of a mind, to become either wholly or in part deranged.

Setting aside these extreme cases of wounded birds, and looking closely at birds at large, we will find a vast difference in the relative vivacity and agility of our feathered friends. This difference, of itself, is interesting; but become familiar through gentleness with the robins and cat-birds that are building their nests near your homes, and make the acquaintance of the bluebirds, sparrows, and wrens, and every creature of the avi-fauna of your neighborhood, and you will surely find among them, here and there, some melancholy individual that has no home, if we limit birds' homes to their nests, and certainly with no visible means of support, if it depends upon its mate to take care of him or her, as the case may be. These birds, unmated, moping, and almost voiceless, are, to say the least, eccentric. One instance in particular is vividly recalled, that of a meadow-lark (*Sturnella magna*) which for hours would sit upon a certain limb of a dead tree, and only leave it voluntarily for a short time to feed. It never sang, and when on the ground did not associate with its kind, but trotted about with chipping sparrows, along the garden fence. Its one peculiarity, marked above all others, was the resentment with which it met the advances of its fellows. If one perchanced to alight on this crazy lark's adopted home, it would be vigorously attacked, and the intruder invariably was driven off. At such a time it would utter a vigorous chirp, but at no other time did I hear any note uttered. It remained thus, in the one limited spot, for three weeks, and was then found lying dead at the foot of the tree. Dissection showed no peculiarity in the anatomy of its brain or viscera, and there was no indication that it died either of grief or starvation. I believe it simply a case of insanity. Another such case was that of a cat-bird.

This poor fellow for the greater part of one summer haunted a row of currant bushes, in a very melancholy mood the while, and when seen by other cat-birds, they would immediately give it chase. The persecuted bird was readily recognized by having a single snow-white feather in its tail, which was otherwise of normal size and color. It is not to be supposed that albinism which extended only to one feather could have been the cause of this ostracism, and we refer the cause to the mental state of the bird, and that being recognized as weaker and perhaps otherwise unnatural, they would have killed it had it not been able to escape their attacks by taking refuge in dense foliage close to the ground. Its movements indicated physical health, its loneliness and inability — shall we say? — to please its fellows, indicated mental ill health, that is, insanity.

It is scarcely necessary, and space forbids our going further into details in the elaboration of such phases of bird life as, to human comprehension, are apparently identical with the allied acts in man; and, indeed, if it can be shown that under any one circumstance a bird thinks, it as satisfactorily determines that the creature has a thought-producing brain, as though we trace his mental powers from the nest to the close of adult life. Have we not more than one such circumstance here narrated, as a "proof that birds possess a faculty indistinguishable, so far as it goes, from human reason"? When noting the circumstances of limited migrations, we saw that it was not a blind movement on the part of each individual, but the influence being alike recognized by all, they congregated and departed with a full knowledge of whither they were going, this predetermination being shown by the character of their movements while journeying. The validity of the opinion that birds fully comprehend and attach definite meanings to their range of utterances we endeavored to show in the flocking of allied species and genera, instead of the promiscuous assembling of birds of widely differing types. Their love of company was pointed out as bearing, too, upon the subject of language as man understands it, being also an attribute of birds, this association extending beyond the duration of nidification, and not limited to single pairs, but the individuals of each species residing in considerable areas. This love of the company of their own kind is not a mute association, but marked by an extensive range of vocal powers other than their songs proper, which bear the relation to language that singing does to conversation in ourselves, and bear every indi-

cation of being expressed for the purpose of conveying to others thought on the part of the utterer. When birds are nest-building I have shown that the subject of future requirements is duly considered, when *the thought* occurs to the busy birds, and is acted upon by both, after its necessary communication by one to the other, in an intelligent manner, thereby demonstrating a cerebral action identical with that of man when analogously circumstanced. I have endeavored to show that cunning on the part of crows was largely acquired, and differed in individuals, showing a variation in brain power, and also that their association was too well organized to be looked upon as other than one where there were some superior intellects to guard the interests of their masses. Finally, we have seen that the ordinary physiological effects of alcohol, such as obtain in man, render birds liable to drunkenness when they unwittingly indulge too freely; and just as their brains, as do human brains, respond to its effects, so there is also abundance of reason for believing that insanity, too, may arise from just such causes as produce this malady in man.

Thus, rapidly glancing over the range of bird-life, in its feral state and in confinement, in health and in disease, we may see that much that is often thought peculiar to mankind is partially, also, an attribute of birds. We must, if disposed to see all animate nature with unbiassed minds, grant to these lower forms a higher grade of intelligence; and if, as yet, we cannot bridge the chasm that separates us from them, it is not so much that the chasm is too broad as that our pride and ignorance vainly supposes it to be wider than it is.

THE AGE OF THIS EARTH.

BY H. P. MALET.

AN able article in the *Quarterly Review* for July, 1876, gives the calculations of several sciences, differing from one another by tens and hundreds of millions of years, on the age of our cosmical system.

Physical geography was not represented; we claim for it not only as great a knowledge of facts in reference to the main point as any other science possesses, but the means of enabling us to point out where other sciences seem to be in error as to time, to data, and consequently in their complex calculations.

Mathematicians are so correct in their figures that when they start from one point to reach one end, their ends ought to be the same; when these ends vary and we find no fault in the calculation, we must look into the data for the cause of variation and error.

The article alluded to gives us an outline of cosmical beginnings from the theory of Laplace, published in 1796 (Maunder). Astronomers had been aware that many nebulæ floated in space; these became "specimens of worlds in making," under the powerful telescope of the French astronomer. As the nebulæ became denser, they came under "the action of gravity;" consequently "a succession of rings, concentric with and revolving round the centre of gravity," were formed. "Each ring would break up into masses, which would be endued with motions of rotation, and would in consequence assume a spheroidal form. These masses formed the planets, and gathering with energy round its centre formed the sun." It is then explained "that the earth could not have had an independent existence till long after that time . . . for before then the earth must have formed part of the fiery mass of the sun;" the *Quarterly* observing, "Thus, probably, was the world we live in and the solar system of which we form a part evolved out of chaos."

Science has proved that motion causes heat, and therefore the sun was provided with a supply by the action of the nebulæ. If they were cold when they came together, — the only condition they could have been in, — the supply of heat was calculated to last for 20,250,000 years at the present rate of consumption. Thus "the dynamical theory of the sun's heat renders it almost impossible that the earth's surface has been illuminated by the sun's rays many times ten millions of years; and when we consider underground temperature, we find ourselves driven to the conclusion that the existing state of things on the earth, life on the earth, and all geological history showing continuity of life must be limited within some such period of time as 100,000,000 years." This authority, Sir William Thomson, is reported to have told the British Association at Glasgow that "50,000,000 years is an even estimate" for the age of this earth.[1]

A comfortable margin of fifty per cent. seems convenient to the precise sciences. Professor Tait is reported to have said in a late lecture at Glasgow, in alluding to differences on this subject, "So much the worse for geology as at present understood by its

[1] The Mail, September 8, 1876.

chief authorities, for physical considerations render it impossible that more than 10,000,000 or 15,000,000 of years can be granted." Before entering on physical details it will be as well to point out a curious question between mathematicians and geologists in reference to "under-ground temperature." Some geologists assign all igneous action on this earth to local chemical causes; but the fashionable school allows its ignorance on this subject in the Text-Book of Geology, by Mr. Page, seventh edition, page 51: "The occurrence of volcanoes, earthquakes, escapes of heated vapors, and thermal springs are by far too numerous and general to be accounted for on any principle of chemical union with which we are acquainted." In other words, the expenditure of heat from the earth is supposed to be more than local chemical causes could supply. Mathematicians give "20,250,000" years of heat to the sun; as this earth is supposed to have been an offshoot from its "fiery mass," we may infer that when the earth was detached it must have been in the same hot condition as the parent mass. Mr. Proctor gives us the diameter of the sun at 850,000 miles, and Guyot's geography gives the diameter of this earth at eight thousand miles. If, then, the diameter of the sun contains heat for 20,250,000 years, the diameter of this earth can hold heat only for 190,588 years. We know nothing of fresh supplies of fuel to earth or sun, in reference to the theory of Laplace; we give the sun the credit for greater expenditure of heat than the earth; but if geologists are right in supposing that local chemical causes have been unequal to the earth's expenditure, and that this has been going on for ten, twelve, fifty, or one hundred millions of years, according to the calculations of physical science, we may wonder why the internal fire did not become bankrupt long ago. We may also remark, in passing, that if igneous action is of any advantage to this earth, it is lucky that neither science had any hand in its origin.

It was pointed out by the German metaphysician, Kant, and has been accepted by others, that there has been a retardation of the earth's revolution from the tidal wave. The conclusion, as given in the *Quarterly*, is, "She was rotating at about the same rapidity as now when she became solid, and as the rate of rotation is certainly diminishing, the epoch of consolidation cannot be more than ten or twelve millions of years." This calculation cannot be of much consequence to the cosmical system; but as no one knows how the tidal wave acted before there was land for it to flow and ebb upon, we put the theory down as useless,

and accept the tidal action as a part of the dynamical action, that helps to keep the whole sphere in equilibrium.

We now come to a mixture of mathematics and geology. The late Sir Charles Lyell, calculating from the present growth of the dry land, put the age of this earth at 300,000,000 years, the fossiliferous strata at 240,000,000, and the Glacial epoch at 1,000,000 years ago.

The earnest and accurate mathematician, Croll, endeavors to modify the geological epochs by a calculation "at once beneficial, simple, and complete. . . . The land has been many times under the sea, and the most violent changes of climate have succeeded one another." Causes are produced to show "that every ten thousand years, or thereabouts, the winter of the northern hemisphere will occur, . . . whenever any records are left of the Glacial epoch, a general subsidence of the land followed closely on the appearance of the ice, . . . the extent of submergence will be in proportion to the weight of ice, . . . glaciation would be transferred from one hemisphere to another every ten thousand years. There would be elevation of the land during the warm period, and subsidence during the cold."

The article goes on to tell us that "the discovery of Mr. Croll upsets the whole scale of geological time." Croll gives four periods of glaciation, the last of which was 200,000 years ago; so that the Glacial period is reduced to that age, the date of the fossiliferous rocks to 48,000,000, and the age of the earth to 60,000,000 of years.

All glacial epochs are supposed to have left their marks behind them. Croll says they occur every ten thousand years, but the writer of the article has left out twenty of these periods, and selected one of Mr. Croll's without knowing whether Sir Charles Lyell referred to that particular period or to another which Croll tells us took place 850,000 years ago. As figures go in this matter, Sir Charles would have a very small margin of 150,000 years if he worked on the traces of this period. The writer of the article seems to have had an object in his figures by reducing them as nearly as possible to his own.

We must now consider two more facts brought forward by Croll in support of his calculations: —

First: "The land has been many times under the sea." . . . "The submergence will be in proportion to the weight of ice." The latter quotation cannot be proved; ice vanishes, and its weight cannot be known. Submergence of land takes place all

round the world. The causes are soft foundations and growing superstructures, pressures, sinkings below water, sedimental gatherings, gradual risings, and the repetition of the same actions till a solid foundation is secured. When foundations are undermined by subterranean water action, submergences of surface areas occur suddenly, and the rising again is uncertain.

Second: "Violent changes of climate have succeeded one another." Opinions vary as to the cause of this in the arctic regions. Some follow Mr. Croll in his see-saw theory, or the oscillation of the poles. If it takes place, changes of climate must ensue; but a very material point seems to have been forgotten, — if the oscillation is cosmical the water would go down with the land, there would be no submergence. There would be ten thousand years of ice and ten thousand years of warmer climate. These changes would be general, but the fossils of warmer regions do not prove a general growth, neither do the warm-region drifts of the present prove a general action through the arctic regions. In the late arctic expedition it was colder on one shore of Smith Sound than on the other; and Captain Sir George Nares gave this experience of the Arctic and Atlantic Oceans to the Royal Geographical Society.

In the Atlantic Ocean there is "an enormous reservoir of heat." This warm water is forced "gradually towards the northward and eastward, modifying the climate of all parts lying in its course. There is also a warm current ever running to the northward through Behring's Straits." These warm supplies run at present through certain channels, while in other channels "an icy cold current" runs to the southward. The polar basin has a "warm stream of water constantly pouring into it between Spitzbergen and Norway, and a cold icy one as constantly running out between Spitzbergen and Greenland, also . . . between Greenland and America; . . . so great is the difference of climate caused by these powerful distributors of heat and cold that the temperature of the sea . . . twenty-two hundred miles from the equator is precisely the same as that nearly double the distance from the equator."

As we have these cosmical actions, guided by fixed cosmical laws, perpetually circulating the heat and the cold, — not always in the same channels, but distributing both according to the direction of either current, — we find a certain cause for the "violent changes of climate" alluded to, instead of the more than uncertain oscillation with the doubtful results of Mr. Croll. We

cannot agree with the author of the article in the *Quarterly*, or allow that this Glacial theory in any way interferes with geological time as laid down by the late Sir Charles Lyell. Having thus disposed of certain details as to the age of this earth, we must now briefly consider the position of our geological science on this point.

Properly speaking, geology is a discourse of things on or in the earth, of things tangible and visible. Geologists in accepting the theory of Laplace, make the foundation of their science neither tangible nor visible. It suited geology to adopt it because, in the prevailing ignorance of natural laws, it seemed to explain the causes of certain phenomena. Now that a more accurate knowledge of cosmical law is creeping up, there is no excuse for adhering longer to a theory which is incapable of explaining the cause of igneous phenomena on or in the earth, while it is made ridiculous by the little figures of the mathematicians.

We cannot meet the dogmas of science on this subject because we think with a finite mind on an infinite beginning; but we ask geologists and mathematicians to follow us through a brief tracing of the cosmical laws and their actions from that beginning, as far as that has been revealed to us till now.

There was a void chaos of waters without form, and dark; how long this earth remained in this condition we do not know. A water-bed was formed, light was given, motion, day and night ensued, revolution of the earth on its axis had commenced and continued to this sphere its hours of labor and of rest. Another result followed the presence of light: water was attracted by it, as it is to-day; the water clouds were collected in the firmament, and were divided from the waters under the firmament; all this law is in force now, but no one can say how long a time elapsed before the action became perfect and complete.

As the light caused a movement in the waters, so the waters acted on their bed. No one can say where the general level of that early bed was. But as it deepened from the ever-acting erosion of the waters, they were of necessity gathered unto one place, and the bed which they had rested on became dry land.

No science can tell when this happened; we do not know where the first water-level was, the level of the dry land or its locality; no one knows when light first shone upon earth, or when it first divided the waters; we cannot say how long the atmosphere and the water were occupied in forming the silicious nucleus of our earth, but we know that it gives silicious matter

now. We cannot tell when the water was separated from the atmosphere, or how long the atmosphere retained in itself the elemental constituents of water and of earth. The mathematician and geologist have nothing to do with the subject before this event took place; there is nothing visible or tangible, no data for a single figure. The moment dry land is created the physical geographer begins his labors. They are not difficult; he knows the uncertain forces that work under cosmical laws on forever changing materials; by knowing the results at present, he can tell those of the past. Far be it from us to suggest infallible action; we can but give a faint outline of the whole, but we give nothing that cannot be verified by the law and its actions at the present moment.

The geographer looks through time upon the face of the first dry land; he sees the water-sheds giving out their little trickles all running down the slopes, all wearing away something in their course, all depositing some atoms on their way, and all carrying on to their little estuaries or deltas a constant succession of minute atoms. He sees the deltas constantly extending by the addition of atoms, and constantly rising in consequence of the retiring of the waters. He sees constant additions to the dry land made by the water in one place, and constant abstractions in another; he knows that every atom taken from the water-bed makes that bed deeper, and every atom taken from dry land helps eventually to extend its shores.

Under these actions he comprehends that the dry land must have gone on growing, and that the undulating ocean bed must have grown deeper where its currents ran, and shallower where they did not; he traces the gradual growth of these shallow places, not by any forcible elevation of the mass, but by the slow departure of the water, by the sediments left upon them, by the eventual growth of vegetation, by the creation of life, by the elemental forces forever returning to their dusts, in some regions or another, to the extending deltas and the growing dry land.

He looks upon the mud and sand-banks of to-day and sees the same forces at work under the same laws; he knows that these forces acted under the same laws at the beginning, and he knows that they acted on the materials then available as they act on the materials of to-day. He marks through legends, history, and his own experience the denudations and the additions of the sea-shores; he finds that in thousands of years the general contour of the dry land has remained the same; he finds that localities have

been added to and taken away. In these subtractions he sees the fossil remains of prehistoric organic structure torn from their resting-places in the calcareous rocks, he handles the flint nodule formed from the silicious dusts of diatoms and foraminifera, and finds the same dusts in course of deposit in the deepest parts of the ocean, telling him, not only that these organisms have continued their races for millions of years, but that they have, for all those ages, left their dusts to subside upon the ocean bed, certain evidence that the site on which we find the stratified calcareous rocks, with their lines of flint nodules, was once the ocean bed. He may look on the sand collections now on our surf-beaten shores, on the wind-drifts of the great deserts, and on the sand-dunes in many regions; he does not know when they began to grow, but he sees on mountain sides sandstone rocks several hundred feet in thickness, many miles in length and breadth. He knows that they were formed and gathered by the same forces that now occupy hundreds of years in adding a few inches to the shores, and he is lost in thinking of the vast amount of silicious matter broken up, triturated into sand, and deposited by the water on its bed, and that bed hundreds of feet above his head. He finds the hard silicious rock in stratified form on the tops of our highest mountains, in their interior, and in the deepest seas, where it still wears away and contributes atoms for deposit in other places. He is lost in the time occupied by the deepening of the sea, by the vastness of the deposits formed by it, far above its present surface level, and by the extent of deposit now in progress in its depths. The geographer knows that every river is always bringing something to its estuary, yet its growth of dry land is very slow; he measures it, but he cannot tell by that measurement when the estuary of the Nile was four thousand miles from its present site. He may trace the Mississippi from its present watery delta back to its tributaries in the Rocky Mountains, but it does not tell him when these, now great, waters trickled as little rills from the first dry land of those regions. He looks upon the water-worn chasms of the Himalayas and the Alps, on the vast gorges of great rivers; he cannot say when those rivers began to run, or how long it took them to wear away the hard obstruction to their course, any easier than Sir Charles Lyell could tell the age of the Niagara Gorge.

He may see the vast structure of the coral insect [*sic*] now growing over thousands of miles in the Red Sea, but he does not know when those structures were commenced. He sees the stu-

pendous mass of the dolomite mountains: he knows that these were all lodged as sedimental matter where they now stand by the same water forces which had previously built up the silicious Alps; that all the materials of which they are formed were brought atom by atom, just as atoms are lodged on our sea-coasts to-day, by the waters, which were then deeper than the mountains are high, from places on the sea-bed which were shallower, places that were washed away, and deepened by the very force that broke up the coral banks, carried them away, and lodged them where they are. He can form no idea where or when the insects lived that gathered all this calcareous matter from their water, how long it occupied them in constructing their palaces, how long they existed, when they were pulled to pieces, how long they were triturated by current and by wave, or when the atoms were permitted to become deposits.

He may look on the calcareous matter of the Jura Mountains and know that they are formed from bones and shells of a fauna that once lived on land or in the water; he knows that these masses were lodged in water as deep as the mountains are high, in minute fragments, with an occasional entire shell or an unbroken bone, but he knows nothing of the land or water in or on which the fauna lived. He cannot count the time occupied in the formation of these mountains, or tell for how many ages the fauna lived that left their dusts to form them. Wherever the physical geographer turns he is lost in the lapse of ages. The waters have left their old beds, the land has acquired new dimensions. All dry lands have their high places, from which their water-sheds convey their atoms away; every atom helps to extend dry land; the water-sheds are the agents for the work, and the great waters are the agents for the separation of matter, and for its deposit in its proper place. All this is done now under certain laws by the cosmical agents, air and water.

No one knows better than the physical geographer the truth of the words used by the writer in the *Quarterly Review:* "In all the operations of nature . . . God worked by law, . . . by the process of slow development, by means beautifully simple, involving no violence, no haste, yet irresistible." No one sees more clearly the error, ascribed to Professor P. G. Tait, in *The Mail*, 8th January, 1877: "The present state of things has not been evolved through infinite past time by the agency of laws now at work, but must have had a distinct beginning." "When was it, and what was it?"

It is the slow, the certain, the beautiful, and the unchanging process of cosmical law, which gives the character of infinite to the universe. Finite man has not as yet read the pages of the law, and cannot therefore calculate the age of this earth. He has tried over and over again to do so, but Professor Tait is not so near to the truth as Solomon was; other "guesses" (*Quarterly*) may be nearer, but the men who guess are at present without chart, compass, or sounding-line on the fathomless and boundless ocean of eternity. — *The Geographical Magazine.*

EVOLUTION IN THE NETHERLANDS: TESTIMONIAL TO MR. DARWIN.[1]

WE have great pleasure in printing the following correspondence: —

UTRECHT, *February* 20, 1877.

TO THE EDITOR OF NATURE, — On the sixty-ninth birthday of your great countryman, Mr. Charles Darwin, an album with two hundred and seventeen photographs of his admirers in the Netherlands, among whom are eighty-one doctors and twenty-one university professors, was presented to him. To the album was joined a letter, of which you will find a copy here inclosed, with the answer of Mr. Darwin.

I suppose you will like to give to both letters a place in your very estimable journal, and therefore I have the honor to forward them to you.

P. HARTING,
Professor, University, Utrecht.

ROTTERDAM, *February* 6, 1877.

SIR, — In the early part of the present century there resided in Amsterdam a physician, Dr. J. E. Doornik, who, in 1816, took his departure for Java, and passed the remainder of his life for the greater part in India. His name, though little known elsewhere than in the Netherlands, yet well deserves to be held in remembrance, since he occupies an honorable place among the pioneers of the theory of development. Among his numerous publications on natural philosophy, with a view to this, are worthy of mention his "Wijsgeerig-natuurkundig onderzoek aan gaande den vorspronkelijken mensch en de vorspronkelijke stammen van deszelfs geslacht" (Philosophic Researches concerning Original Man and the Origin of his Species), and his treatise,

[1] From Nature, London.

"Over het begrip van levenskracht uit een geologisch oogpunt beschouwd" (On the Idea of Vitality considered from a Geological Point of View). The first appeared in 1808; the latter, though written about the same time, was published in 1816, together with other papers more or less similar in tendency, under the title of "Wijsgeerig-natuurkundige verhandelingen" (Treatises on the Philosophy of Natural History). In these publications we recognize Doornik as a decided advocate of the theory that the various modifications in which life was revealed in consecutive times originated each from the other. He already occupies the point of vantage on which, shortly afterwards, Lamarck, with reference to the animal kingdom, and, in his wake, Prévost and Lyell, with respect to the geological history of our globe, have taken their stand.

Yet the seeds scattered by Dr. Doornik did not take root in fertile soil. It is true that a Groningen professor, G. Bakker, combated at great length some of his arguments regarding the origin of man; they attracted but little public attention, and soon passed into oblivion.

A generation had passed away ere the theory of evolution began to attract more attention in the Netherlands. The impulse was given by the appearance of the well-known work, Vestiges of the Natural History of Creation, of which a Dutch translation was published in 1849 by Dr. T. H. van den Broek, professor of chemistry at the military medical college in Utrecht, with an introductory preface by the celebrated chemist, Prof. G. T. Mulder, as well known in England as elsewhere. This work excited a lively controversy, but its opponents were more numerous than its partisans. Remarkably enough, it found more favor with the general public, and especially with some theologians of liberal principles, than with the representatives of the natural sciences. The majority of zoölogists and botanists of any celebrity in the Netherlands looked upon the writer's opinions as a chimera, and speculated on the weaker points rather than on the merits of the work. Notwithstanding, this presented no obstacle to a comparative success, and in 1854 even a third edition of the translation was published, enriched by the translator with numerous annotations.

Among the few Dutch *savants* to recognize the light which the theory of development spreads over creation must be mentioned two Utrecht professors, namely, F. C. Donders and P. Harting. The former, in his inaugural address pronounced in 1848, "De

Harmonie van het dierlijk leven, de Openbaring van Wetten" (The Harmony of Animal Life, the Revelation of Laws), expressed his opinion that in the gradual change of form consequent upon change of circumstances, may lie the cause of the origin of differences which we are now wont to designate as specific. The latter, in the winter of 1856, delivered a series of lectures, before a mixed audience, on The History of Creation, which he published the following year under the title of "Voorwereldlijke Scheppingen" (Antemundane Creations), with a diffuse supplement devoted to a critical consideration of the theory of development. Though herein he came to a stand-still with a "non liquet," yet it cannot be denied that there gleamed through it his prepossession in favor of a theory which several years later his famed and learned colleague, J. van der Hoeven, professor at Leyden, making a well-known French writer's words his own, was accustomed to signalize as an explanation, "De l'inconnu par l'impossible."

In 1858 your illustrious countryman, Sir Charles Lyell, was staying for a few days in Utrecht. In the course of conversations with this distinguished *savant* on the theory of development, for which Lyell himself, at least in his writings, had shown himself no pleader, the learned of this country were first made observant of what had been and what was being done in that direction in England. He attracted attention to the treatise of Wallace in the *Journal of the Linnæan Society*, and related how his friend Darwin had been occupied for years in an earnest study of this subject, and that ere long a work would appear from his pen, which, in his opinion, would make a considerable impression. From these conversations it was evident that Lyell himself was wavering. In the following edition of his Principles of Geology, he declared himself, as we know, a partisan of the hypothesis of development, and Professor Harting speedily followed in the same track. In his "Algemeene Dierkunde" (General Zoölogy), published in 1862, he was able to declare himself with full conviction a partisan of this hypothesis. Also another famous *savant*, Miquel, professor of botany at Utrecht, who had previously declared himself an opponent of the theory of development, became a convert to it in his later years, for although this is not expressed in his published writings, it was clearly manifest in his private conversation and in his lectures. To what must this conversion be attributed? With Harting and Miquel, as well as with Lyell and so many others in every country of Europe, this was the fruit produced by the study of your Origin of

Species, published in 1859, which first furnished one vast basis for the theory of development. That work, translated into Dutch by Dr. F. C. Winkler, now conservator of the geological, mineralogical, and palæontological collections in "Teyler's Foundation" at Haarlem, excited great and general interest. It is true that a theory striking so keenly and so deep at the roots of existing opinions and prejudices could not be expected at once to meet with general approbation. Many even amongst naturalists offered vehement opposition. Prof. J. van der Hoeven, bred up as he was in the school of Cuvier, endeavored to administer an antidote for what he regarded as a baneful poison by translating into our tongue Hopkins' well-known article in *Fraser's Magazine*. However, neither this production nor the professor's influence over his students could withstand the current, especially when, after his death, the German zoölogist, Prof. Emil Selenka, now professor of zoölogy at Erlangen, was appointed at Leyden. A decided advocate of your theory, he awakened in the younger zoölogists a lively enthusiasm, and founded a school in which the conviction survives that the theory of development is the key to the explanation of the history of creation.

In Utrecht, Professor Harting, with convictions more and more decided, was busy in the same direction; and Selenka's successor in Leyden, Prof. C. K. Hoffmann, did not remain in the rear. Other names, among which are Groningen and Amsterdam professors, might here be cited. By the translation of your "Descent of Man" and "The Expressions of the Emotions in Man and Animals," with copious explanatory notes, and by various original papers and translations treating on your theory, Dr. Hartogh Heys van Zouteveen has also largely contributed to the more general spread of your opinions in the Netherlands.

To testify how generally they are held in esteem among the younger zoölogists and botanists, and more and more obtain among professors of analogous branches in this country, we might refer to a multitude of less important papers and articles in the periodicals.

This, however, we deem superfluous, since by offering for your acceptance an album, containing the portraits of a number of professional and amateur naturalists in the Netherlands, we offer a convincing proof of our estimation of your indefatigable endeavors in the promotion of science and our admiration of you, sir, as the cynosure in this untrodden path. We recognize with pleasure Dr. Hartogh Heys van Zouteveen as the primary mover

of such a demonstration of our homage. The execution, however, devolved upon the directors of the "Netherland Zoölogical Society," who reasoned that, with the presentation of this unpretending mark of esteem, a few words on the history of the theory of development in the Netherlands would not be entirely unacceptable, the more so, since this historic sketch clearly shows that, albeit some ideas in that direction had already been suggested here, yet to you alone reverts the honor of having formed by your writings a school of zealous and convinced partisans of the theory of development.

Among the names in the accompanying list you will observe several professors of natural history, anatomy, and physiology at the three Dutch universities, the "Athenæum Illustre" of Amsterdam, and the Polytechnical Academy of Delft, the conservators of the zoölogical museums, the directors of the zoölogical gardens, and several lecturers on zoölogy and botany at the high burghal schools.

Accept, then, sir, on your sixty-ninth birthday, this testimony of regard and esteem, not for any value it can have for you, but as a proof, which we are persuaded cannot but afford you some satisfaction, that the seeds by you so liberally strewn have also fallen on fertile soil in the Netherlands. We are, sir, etc., the directors of the Netherlands Zoölogical Society,

(Signed) President, A. A. van Bemmelen,
Secretary, H. T. Veth.

The following is Mr. Darwin's reply: —

Down, Beckenham, *February* 12.

Sir, — I received yesterday the magnificent present of the album, together with your letter. I hope that you will endeavor to find some means to express to the two hundred and seventeen distinguished observers and lovers of natural science who have sent me their photographs, my gratitude for their extreme kindness. I feel deeply gratified by this gift, and I do not think that any testimonial more honorable to me could have been imagined. I am well aware that my books could never have been written, and would not have made any impression on the public mind, had not an immense amount of material been collected by a long series of admirable observers, and it is to them that honor is chiefly due.

I suppose that every worker at science occasionally feels depressed, and doubts whether what he has published has been worth the labor which it has cost him; but for the remaining

years of my life, whenever I want cheering, I will look at the portraits of my distinguished co-workers in the field of science, and remember their generous sympathy. When I die the album will be a most precious bequest to my children. I must further express my obligation for the very interesting history contained in your letter of the progress of opinion in the Netherlands, with respect to evolution, the whole of which is quite new to me. I must again thank all my kind friends from my heart for their ever-memorable testimonial, and I remain, sir, your obliged and grateful servant, (Signed) CHARLES R. DARWIN.

RECENT LITERATURE.

MIVART'S LESSONS FROM NATURE.[1] — Any one who expects to find in this book a series of mild and temperate homilies on the lessons to be derived from a study of nature will be disappointed. There is rather more said about the works of certain of Professor Mivart's fellow naturalists and philosophers than of the works of nature, and the book is more polemical than prosy. Herbert Spencer and Professor Huxley are criticised, often with good effect, and their weak points — for they have them — exposed. But the author in his criticisms of the agnostic school of philosophers is a little one-sided. In the present state of philosophy and science, the attitude of nescience may be a healthy and natural one. The author, while in his anatomical workshop using the tools of the agnostic, seems when wearing his philosopher's spectacles to look at creation in quite a different mood. In his fears of the ultimate prevalence of a purely scientific mode of thinking, he does not take into account the low specific gravity and enormous density of the mass of superstition in the world, the wrong thinking, sometimes even amounting to insanity, resulting from crude and mistaken pseudo-religious conceptions, which have done and will tend to do infinitely more harm to the race than the class of conceptions denominated by some writers as agnostic, and which must for centuries to come be held by the few. While one may not agree with the extreme views of Spencer, Huxley, and particularly Haeckel and others who have, as some believe, established a sort of "scientific priesthood" with a more or less one-sided, bigoted following, yet the criticisms coming from that quarter will do most efficient service in making men think and feel more rationally.

It will be gathered from the foregoing remarks that Professor Mivart's Lessons is really a criticism of the evolution school of naturalists by one who from being an extreme Darwinian has become a moderate evolutionist *sans* any taint of what is known as materialism, and who con-

[1] *Lessons from Nature, as manifested in Mind and Matter.* By ST. GEORGE MIVART. New York: D. Appleton & Son. 1876. 12mo, $2,00.

sequently entertains views which enable him to acknowledge the pope, and perhaps Lamarck as well, as his master.

Mr. Mivart believes that man forms a kingdom by himself, and that "he differs absolutely, and therefore differs in origin also;" least of all does he — and he thus agrees with Mr. Wallace — believe that he originated "from speechless, irrational, non-moral brutes." Our author's opinions on the nature of instinct strike us as very old-fashioned and irrational. He thinks there is "no need whatever to credit brutes with intellect: first, because all the phenomena they *do* exhibit can be accounted for without it, while they *do not* exhibit phenomena characteristic of a rational nature."

The chapter on mimicry is an excellent criticism on this phase of Darwinism, which with sexual selection is one of the weak buttresses of the theory of natural selection. In considering the last-named theory of Mr. Darwin, Professor Mivart brings forward the objections made to it in his former work, Genesis of Species. He shows that Mr. Darwin has modified his own view of his own theory, until he is led to regard it as "the most important, but not the exclusive means of modification." Mr. Mivart's own views coincide with those of Professor Parsons, of Cambridge, Mass., and Professor Owen, of London. We are not so sure that the theory of natural selection will not in the future hold a subordinate place and form but a single phase of a many-sided theory, of which the corner-stone has possibly not yet been discovered. Meanwhile we must say that such hearty, trenchant criticism as that of Mr. Mivart is a healthy sign in a country like England, where personal authority exercises such sway over the minds even of agnostics. It should be remembered, however, that Mr. Darwin, if he has not proposed a theory which will be universally satisfactory as a working hypothesis, has sown the seeds from which will arise a plenteous harvest of new facts and suggestions which may lead to the discovery of a true and comprehensive theory of evolution. His methods are legitimate and truly scientific. We miss in the Lessons from Nature any proper appreciation of Mr. Darwin's labors, and regret that in this, as well as in criticisms by other authors, a truer appreciation is not shown for Mr. Darwin's methods and his personal genius.

Professor Mivart is one of the foremost anatomists in England. His literary and philosophical ability, as well as polemical skill, shine in these Lessons; and we confess that when a good Catholic heartily indorses a theory of evolution, though quite opposed to a mechanical theory, as pure Darwinism perhaps is, we feel quite satisfied that the world is progressing.

Dolbear's Art of Projecting.[1] — So frequently is the magic lan-

[1] *The Art of Projecting.* A Manual of Experimentation in Physics, Chemistry, and Natural History with the Porte Lumière and Magic Lantern. By Prof. A. E. Dolbear. Illustrated. Boston: Lee and Shepard. 1877. 12mo, pp. 158. $1.50.

tern used in lectures upon natural history that a manual of the use of the lantern and of the art of projecting in general is a timely publication. Professor Dolbear's manual is in all respects excellent, being simple, practical, and fully illustrated. Besides the porte lumière and magic lantern, other apparatus is described and figured, so that the beginner in the art of projecting can readily acquire the knowledge which with practice will enable him to succeed.

RECENT BOOKS AND PAMPHLETS. — Median and Paired Fins; a Contribution to the History of Vertebrate Limbs. By James K. Thatcher. (From the Transactions of the Connecticut Academy. iii. 1877.) 8vo, pp. 29. 12 Plates.

Palæontological Bulletin. No. 24. A Continuation of Researches among the Batrachia of the Coal Measures of Ohio. By E. D. Cope. (From the Proceedings of the American Philosophical Society, February 3, 1877.) 8vo, pp. 12.

Notes on the Appearance and Migrations of the Locust in Manitoba and the North west Territories. Summer of 1875. By G. M. Dawson. (From the Canadian Naturalist.) 8vo, pp. 20.

On the Genus *Merycochœrus* (Family Oreodontidæ), with Descriptions of Two New Species. By G. T. Bettany. (From the Quarterly Journal of the Geological Society for August, 1876.) 8vo, pp. 14. 2 Plates.

Onion Smut; an Essay presented to the Massachusetts Society for promoting Agriculture. By W. G. Farlow. Boston. 1877. 8vo, pp. 15.

Geographical Surveys in the United States. Remarks upon Professor J. D. Whitney's Article in the North American Review, July, 1875, concluding with an Account of the Origination of the Pacific Railroad. By Gen. G. K. Warren. Washington. 1877. 8vo, pp. 28.

Science Lectures at South Kensington. Outlines of Field Geology. By Professor Geikie. With Illustrations. 12mo, pp. 61. 25 cents. The Absorption of Light and the Colors of Natural Bodies. By Professor Stokes. With Illustrations. 12mo, pp. 43. 20 cents. London and New York: Macmillan & Co. 1877.

On the Classification of some of the Lower Worms. By C. S. Minot. (From the Proceedings of the Boston Society of Natural History.) 8vo, pp. 9.

Notes on the Ancient Glaciers of New Zealand. By Israel C. Russell. (From the Annals of the Lyceum of Natural History.) 8vo, pp. 14. With a Map.

Geological Survey of Alabama. Report of Progress for 1876. By E. A. Smith. Montgomery, Ala. 1876. 8vo, pp. 100.

Brehms Thierleben. Allgemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflage. Erste Abtheilung. Säugethiere. Erster Band. Leipzig. 1876. New York: B. Westermann & Co.

Sketch of the Origin and Progress of the United States Geological and Geographical Survey of the Territories. F. V. Hayden, United States Geologist-in-Charge. Washington. 8vo, pp. 15.

Hypsometric Map of the United States. By Henry Gannett. 1877. Drainage Map of Colorado. Primary Triangulation. By J. T Gardner and A. D. Wilson. Topography. By A. D. Wilson, G. R. Bechler, Henry Gannett, G. B. Chittenden, and S. B. Ladd. Department of the Interior. 1877. United States Geological and Geographical Survey of the Territories, F. V. Hayden in charge.

Annual Report upon the Geographical Surveys west of the One Hundredth Meridian, in California, Nevada, Utah, Colorado, Wyoming, New Mexico, Arizona, and Montana, by George M. Wheeler, 1st Lieut. of Engineers, U. S. A., being Appendix JJ of the Annual Report of the Chief of Engineers for 1876. With Topographical Atlas Sheets. Washington, 1876. 8vo, pp. 355.

Annual Report of the Board of Regents of the Smithsonian Institution for 1875. Washington, 1876. 8vo, pp. 422.

GENERAL NOTES.

BOTANY.[1]

Cross-Fertilization of Aristolochia. — Mr. H. G. Hubbard, now traveling in Jamaica, has communicated to a Western paper some interesting notes on the natural history of the island. His observations on *Aristolochia* are fully confirmatory of the studies of others in the case of *Aristolochia clematitis*. "I have had an opportunity of examining the flowers of *Aristolochia grandiflora*, the 'Dutchman's pipe,' called here the 'John Crow,' or 'carrion flower,' from the putrid stench which it exhales. This flower is one of the largest known. The tube or bowl, about a foot long as it hangs from the vines, makes a very good imitation of the Dutchman's china pipe, but the mouth of the bowl turns forward and expands eight or ten inches in diameter, and from the lower edge of this dangles a slender tail, about a foot long. The whole flower is spotted green and purple, like a diseased liver. Notwithstanding its vile odor and uncanny look, it is the most interesting of flowers. The tube is divided into three chambers by constrictions and valves furnished with backward-pointing bristles, the whole forming a trebly guarded fly-trap. The outer chamber alone gives out the carrion odor, attracted by which, insects enter, and finding themselves deceived try to escape, but the long, recurved bristles which line the walls entangle them when they turn back, but favor their progress through the second trap and into the second chamber beyond. Finally they find their way through the third and last trap, into the third chamber. And here you will find small flies and beetles by dozens, if you open the blooming flowers. Now what is the object of this evident contrivance? The flower is not insectivorous. The entrapped insects are always found alive and in good condition, no dead ones in any of the chambers. In fact, the last one, which they must eventually reach, and which also contains the floral organs, seems to have been especially contrived for their comfort and convenience. It is spacious, unencumbered with bristles, except just about the entrance, where a perfect forest of them renders escape into the preceding chamber impossible, and moreover about the floral organs an abundance of nectar supplies them with food. There is a fine stumbling-block in the way of the believer in the laws of cross-fertilization. As Professor Gray would say, this plant seems to be formed on the plan of 'how not to do it.' Skeptics have pointed triumphantly to the *Aristolochia* as a plant which, with the utmost ingenuity, has provided for insuring self or close fertilization. They had opened flowers in full bloom, found the anthers pouring forth pollen, and the imprisoned insects skipping about the inner chamber completely dusting themselves and its walls with the yellow grains. The stigmatic surface, too, had long been fertilized, its lobes had closed, and having performed its office

[1] Conducted by Prof. G. L. Goodale.

the pistil was withering away. The fact of self-fertilization in this plant seemed proved. Nature, however, does not disclose all her secrets on the first inspection, and a more careful study of this flower in all its stages will show that its wonderful machinery is contrived solely for securing cross-fertilization through the agency of insects, and that it cannot fertilize itself. In fact the anthers and stigma in any flower *are never open at the same time.* The mystery is explained when we examine the flowers that have blossomed and are withering: *the trap is open and the insects all flown.* Each of the three constrictions, which were at first so narrow as only to admit of a small insect pushing its way between the hairs, is now gaping widely open, and all the bristles so wilted and flaccid as to offer no impediment to their escape. Now turning to a bud just bursting into flower, we find the bristles rigid and the trap set. The stigma is now widely open and ready to receive pollen, but the anthers tightly closed and their pollen quite green. Each flower has then a double duty to perform: first, to catch insects which have been liberated by some flower previously in bloom, and to effect its fertilization with the pollen which they bring; second, to feed and hold them there until its stigma has closed and its anthers burst. And, finally, it opens its trap and sends them forth with unimpaired vigor and a fresh load of pollen for the next flower that blooms." — (Kingston, Jamaica, February 28, 1877.)

Pinus mitis. — The attention of botanists living in the Middle States is directed to this tree, which has become rare in the North. As one of the most valuable of North American timber trees, attention has been drawn to this species as suitable for forest culture in many parts of the United States, and it is desirable to procure seed for this purpose from as far North as possible. According to the younger Michaux, *Pinus mitis* was found in his time in New York, Connecticut, and Western Massachusetts, and Mr. Lapham includes it in his catalogue of Wisconsin plants, but there is no evidence that this tree grows so far north at the present time.

Botanists finding *P. mitis* in the States above mentioned, or in Pennsylvania, New Jersey, Ohio, or Michigan, are requested to communicate with the director of the Botanic Garden of Harvard University, Cambridge, Mass. — C. S. Sargent.

Fluorescence of Calycanthus. — A decoction of the bark of the *Calycanthus floridus*, also known as "sweet shrub," is strongly fluorescent. My attention was recently drawn to this fact in examining a mixture of the bark in glycerine, which I had prepared in order to extract the pleasant odor of its essential oil. The vial containing the bark and glycerine when looked at askance emits a rich, bluish shimmer. On comparing a decoction of the bark of this shrub with that of the *Æsculus*, or buckeye, by concentrating the sun's rays with a lens into a cone of light passing through the liquids, I discovered that the Calycanthus decoction

is strikingly superior in intensity and purity of blue color in the fluorescing cone to the Æsculus decoction. — Robert Toombs, M. D., Washington, Georgia.

On the Transformation of Crystallizable Sugar into Cellulosic Products. — M. Durin gives in *Annales des Sciences Naturelles* (iii. No. 4–6) a detailed account of a peculiar fermentation observed by him. Under certain conditions, a solution of crystallizable sugar is converted into cellulose either firm and organized, or swollen, and into inverted sugar. He has never noticed the formation of cellulose from glucose.

Respiration of Roots. — Two different functions have been confounded under the term respiration, namely, assimilation and true respiration. The first of these takes place only through the agency of chlorophyll or its equivalent, and under the influence of light; the latter is common to all plant organs when growing or working. Assimilation is a process characterized by the production of carbhydrates from carbonic dioxide and water, with disengagement of oxygen; respiration involves the oxidation of assimilated matter and is accompanied by the formation of carbonic dioxide. Dehérain and Vesque have lately reëxamined the subject of root respiration, and they have published the following results: —

First: oxygen is necessary for all plant organs. It is not enough for a living plant to have its upper part in the air; it is requisite that the roots themselves should find oxygen in the atmosphere of the soil. Second: absorption of oxygen by the roots is attended by only a slight evolution of carbonic acid; thus roots produce a partial vacuum in the receptacles in which they are confined. Third: the disengagement of carbonic acid takes places as well in an atmosphere deprived of oxygen as in an atmosphere containing it; whence we may conclude that the carbonic acid evolved does not come from a superficial oxidation of organs in a state of decomposition, but as a consequence of the circulation of gases in the plant.

Three Feet of Fern-Spores. — Bureau and Poisson have examined a substance found in large quantities in a cave at Reunion Island. The cave is ten metres in depth by six metres square, and is covered to a depth of more than a metre by a yellow, soft, insipid, inodorous substance, which crumbles under the fingers to an impalpable powder. The dry powder burns without flame or odor, but when moistened gives off during combustion much smoke and odor of a burning plant. By exclusion they have decided that this matter consists of the spores of species of ferns, probably Polypodiaceæ. The spores are not those of Lycopodiaceæ, according to the writers, but they have the shape, markings, and *color* of the spores of the Polypodiaceæ with large fronds now occurring on the island.

Heather in Nova Scotia. — Professor Lawson adds to the locali-

ties of *Calluna vulgaris* on this continent six other stations, and in an interesting paper on the subject gives the following as his conclusions: *Calluna vulgaris* is an indigenous plant, and still exists as such in very small quantity on the peninsula of Halifax. In Point Pleasant Park, at Dartmouth, and possibly in other places, the stations for the plant are artificial, but the plants are probably native. "The various traditions as to the foreign origin of the heather are not unlikely to have been suggested by the desire to account for the presence of what was regarded as necessarily a foreign plant rather than by actual historical facts."

Broom in Cape Breton, and *Rhododendron maximum* at Sheet Harbor, Nova Scotia, are discoveries reported by Professor Lawson.

Analytical Tables. — Professor Ordway, of the Massachusetts Institute of Technology, has sent us copies of analytical tables of the orders of Phænogamia, and of the suborders of Cryptogamia. These are careful synopses of the classifications of Lindley, Hooker and Baker, Schimper, Debat, Müller, Rabenhorst, Harvey, Tuckerman, and Cooke. In view of the present lack of any hand-book on Cryptogams, for the needs of general students, the second table may be found convenient. The author has been most painstaking in his work.

On the Porosity of Wood. — Professor Sachs has published a preliminary communication on this subject in which he gives the results of his recent observations and experiments. The present treatment of the matter is new in some respects, and the conclusions are interesting. An abstract of these will be given in the next number of the Naturalist.

Iris. — Our eastern species of this genus need a thorough revision. The manuals give but two tall species in the Northern States, a broad-leaved and a narrow-leaved one, that is, *I. versicolor* and *I. Virginica* of Linnæus, considering the latter as identical with the *I. prismatica* of Pursh. Now Mr. J. G. Baker, of Kew, in a recent revision of the genus, recognizes two broad-leaved species under the two Linnæan names, and restores Pursh's name for the narrow-leaved plant. Two broad-leaved forms have certainly been cultivated in the European gardens even from the time of Linnæus, and have always been known there by his names and considered distinct. As described by Mr. Baker, and as shown by figures, the most obvious difference appears to be one of size, *I. Virginica* being the taller and stouter, with larger and deeper-colored flowers. Can we find in our wild plants any differences upon which this distinction can be maintained?

Mr. Baker says also that *I. tenax* (a narrow-leaved Oregon species similar to *I. prismatica*) is found in New Brunswick and Canada, and if so it should be looked for within our limits. Moreover the range of all these species is uncertain, especially toward the south, and the southern species generally need revision fully as much as the northern ones. It is probable that careful comparison will reveal new forms from there. The attention of all our botanists is requested to this matter during the

coming season, and specimens of flowers, fruit, and roots, fresh or dried, from any part of the country, may be sent to the Botanic Garden, Cambridge, and will be of service. — SERENO WATSON.

BOTANICAL NOTES FROM RECENT PERIODICALS. — *Flora*, No. 4. Schulzer, Notes on Fungi. Batalin, Mechanism of the Movements in Insect-Eating Plants (not yet finished).

Botanische Zeitung, 1877, No. 6. J. B. Jack, On European Hepaticæ (continued in No. 7). No. 8. Pancic, A new Conifer in Servia. Report of Scientific Societies. No. 9. Celakovsky, On the Greenish Ovules of Trifolium repens. (These are often distinctly foliaceous, and are regarded by the author as metamorphosed leaflets of the carpel.) This paper is continued in No. 10.

ZOÖLOGY.[1]

WINTER BIRDS OF ARKANSAS. — Perhaps it will interest the readers of the NATURALIST to know of some birds which make Central Arkansas their winter quarters. The past winter has been the coldest known for many years, with considerable snow. The following list is certainly far from complete, as we have only been observing birds for a single season. Among the thrushes we have occasionally seen our familiar friend, the robin (*Turdus migratorius*), and the hermit thrush (*T. pallasi*), but usually they desire somewhat warmer weather than we have had this winter.

The mocking-bird (*Mimus polyglottus*) is very plenty around old plantation houses, and exhibits the peculiar markings of the Arkansas specimen spoken of by Baird in his Review of American Birds, page 49. It has an unusual amount of white upon its plumage, and the outer tail feathers clear white.

Perhaps the most abundant bird of the past winter has been the blue-bird (*Sialia sialis*); its food consists largely of the berries of the black gum (*Nyssa multiflora*).

The diminutive golden-crowned kinglet (*Regulus satrapa*) has been observed, as have the tufted titmouse (*Lophophanes bicolor*), the southern black-capped chickadees (*Parus atricapillus* var. *Carolinensis*), the nut-hatch (*Sitta Carolinensis*), and the house wren (*Troglodytes aëdon*). The gay tanager (*Pyranga æstiva*) in his bright red plumage and the female with her more subdued hue have enlivened the landscape all winter.

The snow-bird (*Junco hyemalis*), following the snow-storm southward, was with us in great numbers for about three weeks. The meadow-lark (*Sturnella magna*) is common, so is the noisy blue jay (*Cyanurus cristatus*), proclaiming with harsh notes his close relationship to the crows. The kingfisher (*Ceryle alcyon*) was occasionally seen hovering over the waters of the Little Red River in quest of food.

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

The woodpecker family has attracted our attention all winter by its many representatives, as follows: —

Logcock (*Hylotomus pileatus*), downy woodpecker (*Picus pubescens*) yellow-bellied woodpecker (*Sphyrapicus varius*), red-bellied woodpecker (*Centurus Carolinus*), golden-winged woodpecker (*Colaptes auratus*).

Among the birds of prey we have observed the barn owl (*Strix flammea* var. *pratincola*), barred owl (*Syrnium nebulosum*), and screech-owl (*Scops asio*), and the red-shoudered buzzard (*Buteo lineatus*). The latter feeds in confinement upon dead animals furnished it, but we found by experiment upon a specimen we had procured that it did not do well upon such food, for it died in a week from the time of its capture.

Here we find the turkey-buzzard (*Cathartes aura*) very plentiful. Mourning doves (*Zenaidura Carolinensis*), wild turkeys (*Meleagris galloparo*), quails (*Ortyx Virginianus*), pigeons (*Ectopistes migratorius*), and mallard ducks (*Anas boschas*) are our winter game birds. The first of February finds the farmer in this region sowing oats and planting early garden seeds. At this time, we may say, our winter is over, and our summer birds will soon be with us again. — H. S. Reynolds, Judsonia, White Co., Arkansas.

The Red-Headed Woodpecker Carnivorous. — A friend who resides in Humboldt County, this State, gives me the following particulars of an unusual occurrence: During the summer of 1876 he raised a large number of black Cayuga ducks. It was noticed that while the birds were still very young, many of them disappeared, one after the other, and the bodies of several were found with the brains picked out. On watching carefully to ascertain the cause, a red-headed woodpecker (*Melaneopes erythrocephalus*) was caught in the act. He killed the tender duckling with a single blow on the head, and then pecked out and ate the brains. Though my friend was an enthusiast in protecting the birds and squirrels that came about his premises, this provocation was too much; the shot gun was brought into use, and his ducks were saved from further molestation by a process by which the woodpeckers were "thinned out some." — Charles Aldrich, Webster City, Iowa.

ANTHROPOLOGY.

Anthropological News. — The course of lectures on anthropology, commenced in November last at the Anthropological Institute of Paris, has succeeded beyond the expectation of its founders. In the institute are united three organizations of separate origin: the Society of Anthropology; the Laboratory of Anthropology, founded by M. Broca in 1867, and which has since been attached to L'École des Hautes Études; and the School of Anthropology, founded by private subscription, and sustained by an annual appropriation of twelve thousand francs.

Upon the recommendation of the faculty of medicine, the minister of public instruction has placed at the disposal of the Institute the upper

portion of the Church of the Gray Friars, leaving to them the expense of fitting up the rooms, etc., which has amounted to about fifty thousand francs. In this structure are united the library, the laboratory, the lectures, and the museum, all of which are public. There is nothing wanting to make the course complete. The museum, which results from the union of that of the Society of Anthropology (twelve hundred skulls) and that of the laboratory (twenty-three hundred skulls, skeletons of individuals belonging to different races and of primates, skulls of mammals, prehistoric remains, and anthropological instruments), furnishes to the student the richest material for study, and to the professor all the means of demonstration necessary. We have already mentioned the opening address of M. Broca and the programme. The following table is M. Mortillet's scheme of prehistoric anthropology: —

Times.		Ages.	Periods.	Epochs.
Geological.	Recent. Historic.	of Iron.	Merovingian.	Waberian, Merovingian, Burgundian, Germanic.
			Roman.	Champdolian, Roman decadence.
				Lugdunian, Roman flourishing.
	Recent. Protohistoric.		Galatian.	Marnian, Gallic, 3d Lacustrian.
				Hallstattian, Epoch of Tumuli, 1st Epoch of Iron.
	Prehistoric.	of Bronze.	Bohemian.	Larnaudian, Epoch of the Forge, Upper 2d Lacustrian.
				Morgian, Epoch of the Foundry, Lower 2d Lacustrian.
		of Stone.	Neolithic. Polished Stone.	Robenhausian, 1st Lacustrian, Epoch of Dolmens.
			Palæolithic. Flaked Stone.	Magdalenian, nearly all in Caverns, Epoch of the Reindeer almost exclusively.
				Solstréan, Epoch of the Reindeer and Mammoth partly.
				Moustérian, Epoch of the Cave-bear.
				Acheuléan, Epoch of the Mammoth.
			Eolithic. Fire-flaked Stone.	Thenaisian, Tertiary.

Attention has previously been called to an original paper in the Smithsonian Report for 1875, by C. C. Abbott, M. D., on the Stone Age in New Jersey. The first thing that strikes one in reading the paper is the result that may be obtained in an uninviting field by perseverance. Dr. Abbott has found over ten thousand stone implements in New Jersey, embracing rude objects of unknown use, grooved axes, celts, hatchets, "lance-heads," "hunting-spear heads," "fishing-spear heads,"

arrow-points, knives, "skinning-knives," scrapers, hammers, "chisels and gouges," drilling stones, "breastplates," "gorgets," "banner-stones," "sculptures," pipes, pottery, paint-cups, hoes and shovels, "corn mills," mortars and pestles, "poggamoggons" and net-sinkers, "flaking-hammers," and polishing tools. There is manifested throughout the article a commendable zeal for North American archæology, though, perhaps, too great a fondness for classification and inventing new names, an undue confidence in the ascertained use of certain doubtful forms, and, above all, a too hasty adoption of the generalizations of some English and French archæologists, with reference to the order of culture on our continent. But as we need some adventurous spirits to peer into dark places, these venial faults must not deter us from commending the zeal of Dr. Abbott, and bidding all such "to go up and possess the land."

The next meeting of the Congrès International des Americanistes will be held at Luxemburg, September 10–13, 1877. The following is the programme in full: —

History. The civil legislation of Mexico under the Aztecs and of Peru under the Incas compared. Critical examination of the sources of the history of Central America. Discovery and colonization of Brazil. When and why the New World was called America.

Archæology. General characteristics of the Maya architecture in Yucatan. Of the use of copper in ante-Columbian America. The mound-builders, their origin, antiquity, civilization, and history.

Linguistics. Peculiar characteristics of the Tapi-Guarani family. The grammar of American languages compared with that of the Uralo-Altaic languages. Eskimo dialects compared with other languages of America and with those of Asia.

Palæography. Decipherment of Maya inscriptions and manuscripts. Of the phonetic element in Mexican writing. To what period of American history do the paintings called Mexican hieroglyphics belong? To indicate, as far as possible, the date of the most ancient documents known in that writing. To show what influence was exerted on the development and use of the Mexican figurative paintings by the arrival of the Spaniards.

Anthropology and Ethnography. Of the antiquity of man in America. Of the tradition of the deluge in America, and particularly in Mexico. Ethnographic classification of the inhabitants of Guiana.

M. Bertrand contributes to the *Bulletin de la Société d'Anthropologie*, 1876, pages 100 and 173, papers upon the first Celtic tribes known to the Greeks, who are the only people to mention the Celts previously to 200 B. C. Following up the theme, on page 128 of the same volume, M. Gustave Lagneau has a paper upon the Ethnic Distinction between the Celts and the Gaels, and their Migrations to the South of the Alps. Whatever comes from the pen of this distinguished author is worthy of the highest commendation. The copious references to authorities are a

praiseworthy feature of this treatise. In the *Bulletin*, page 113, is a communication from E. T. Hamy, on The Negritos of Borneo, which also refers to authorities, and is accompanied by two tables, one of cranial and the other of facial measurements. A paper in the *Bulletin*, page 145, upon excavations in the dolmen of l'Aumède (Lozere), is interesting on account of a discussion which grew out of it with reference to cremation in dolmens of this description, and evidences of syphilis. — O. T. Mason.

GEOLOGY AND PALÆONTOLOGY.

The Discovery of Lælaps in Montana. — The carnivorous *Dinosauria* were the largest and most formidable flesh-eating animals that ever lived on the earth, the *Carnivora* of the present day being comparatively insignificant. In the Triassic period the gigantic *Bathygnathus* reduced the numbers of the reptilian life; and in the Jurassic the equally huge *Megalosaurus* devoured the herbivorous *Iguanodon*, etc. In North America the last of these saurian faunæ is abundantly represented in the lignitic beds of the West. Professor Cope has discovered during the past season numerous species of *Lælaps*, some of which were of gigantic size. One of these (*L. incrassatus*) is represented in his collections by a large part of an under-jaw, which is rarely preserved in this class of animals, but three or four others having been heretofore discovered. This animal was about the same size as the New Jersey *Lælaps*, but more robust. Several smaller species were obtained.

The Sea Serpents of the Cretaceous Period. — At one of the recent lectures of the course of the Philadelphia Zoölogical society, Professor Cope exhibited the greater part of the skeleton of a new species of *Elasmosaurus*. The length of the vertebral column is about forty feet, and several feet of vertebræ are wanting. The neck constitutes about half of the total length. The paddles of both pairs are preserved, which is not the case with any other specimen known. They prove to be relatively short, agreeing in this point and in the superior size of the front pair with a restoration he had published some years ago. The specimen was found in Nebraska, and the species was named *Elasmosaurus serpentinus*.

Professor Cope also stated that he had obtained on the Upper Missouri, during his expedition of the past year, a large part of the vertebral column of the *Elasmosaurus orientalis*, from beds corresponding with those in which he had originally found it in New Jersey. This species also has an enormous neck, and was of more robust proportions than the *E. serpentinus*.

The Dentition of the Herbivorous Dinosauria of the Lignitic Period. — At a recent meeting of the American Philosophical Society, Professor Cope exhibited portions of the skulls of several herbivorous Dinosauria, the huge land reptiles that during the lignitic period in North America took the place of the mastodons and elephants of later

ages. He adduced Bartram's articles in proof of the relationship of these animals to the birds which he had originally pointed out from the structure of the feet. He also showed that they possess an extraordinary dentition, much more complex than that known to belong to the same class of animals heretofore described in Europe. The teeth are arranged in vertical columns which constantly grow at the base, and which are kept in place by grooves in the jaw-bones. In one genus, *Dicloniu*s Cope, each tooth of a column overlaps the ends of those above and below it; while in another, *Cionodon*, nearly every horizontal section of the jaw cuts three teeth. It was estimated that there were seven hundred teeth in the mouth of the former genus at one time, and two thousand in the mouth of the latter.

The Lowest Mammalian Brain. — At a recent meeting of the American Philosophical Society, Professor Cope exhibited a cast of the brain cavity of a species of *Coryphodon* from New Mexico, and described its peculiarities. He stated that it is the lowest and most reptilian type of mammalian brain known, for the following reasons: the diameter of the hemispheres does not exceed that of the medulla, which is as wide as the cerebellum. The latter is small and flat. The middle brain is the largest division, much exceeding the hemispheres in size, being especially protuberant laterally. The hemispheres contract anteriorly into the very stout peduncles of the olfactory lobes. These continue undivided to an unusual length, and terminate in a large bulbus, which is at first grooved above, and then bifurcate at the extremity. The length of the hemispheres is one fifteenth that of the cranium, and their united bulk one twenty-seventh that of the hemispheres of a tapir of the same size. Their surface is not convoluted, and there is no trace of sylvian fissure. The region of the pons varolii is very wide, and exhibits a continuation of the anterior pyramids. The large size of the middle brain and olfactory lobes gives the brain as much the appearance of that of a lizard as of a mammal.

Professor Cope stated that three, and perhaps four, other examples of this type of brain are known. The first, described by Professor Gervais, is that of the flesh-eater, *Arctocyon*, from the same lower Eocene horizon as the *Coryphodon*. The next is that of the *Uintatherium*, of the Bridger Eocene, described by Marsh, who states that the hemispheres present a sylvian fissure, in which he is most probably in error, and whose figures do not exhibit the convolutions which he claims to have found. The third is that of the *Oxyæna*, described by Professor Cope, of which the middle brain is unknown, but which is probably like that of *Arctocyon*, in view of the close similarity in other respects.

In reviewing the evidence derived from the preceding sources, the opinion was expressed that the type of brain shown to exist in the *Amblypoda* and *Creodonta* is as distinct from that characterizing the primary divisions of the *Mammalia* as they are from each other, and that

it necessitates the establishment of a special subclass for its reception, of equal rank with the groups *Gyrencephala* and *Lyencephala*. This was called the *Protencephala*, with the following definition: cerebral hemispheres smooth, small, leaving not only the cerebellum but the middle brain exposed behind, and contracting into the very large olfactory lobes in front. Cerebellum very small and flat; middle brain large. This character is sustained by that of the ankle joint, which, existing in two such distinct divisions as the *Amblypoda* and *Creodonta*, may be found to characterize the entire subclass, but this is not yet certain; it is as follows: tibio-astragalar articulation flat and without groove or segment of pulley.

This subclass stands below the *Lyencephala* in its position, approximating the reptiles in the points above-mentioned more nearly than the latter do. It includes two orders: one ungulate, the *Amblypoda*; the other unguiculate, the *Bunotheria*. To the former belong the suborders *Pantodonta* and *Dinocerata;* to the latter the *Creodonta* and probably the *Tillodonta* and *Tæniodonta*. Whether the *Mesodonta* belong to it is not certainly ascertained, while the *Insectivora* do not belong to it, as they are rightly placed in the subclass *Lissencephala*.

GEOGRAPHY AND EXPLORATION.

Farther News from Stanley. — Three letters written in August, 1876, have been received from Stanley. At that time he had reached his old quarters at Ujiji. He had circumnavigated Lake Tanganyika, which is about as large as Lake Michigan. He has apparently added little to what Cameron discovered. He describes a section of the Lukuga River, about eight miles in length, in order to prove that Captain Cameron was incorrect in regarding it as the outlet of Lake Tanganyika, though such, adds Stanley, it is destined to become. He explored Lukuga to a point three miles beyond that reached by Cameron, discovered that the outward current gradually ceased, and that the river-bed finally changed into a marsh thickly covered with papyrus. Following the borders of this marsh for two miles further, he again reached a stream, the waters of which flowed distinctly westward, passing by an abrupt gorge through a mountain range one thousand two hundred feet high. It is called the Luindi, and is a tributary of the Lualaba of Livingstone. Mr. Stanley asserts that the level of Tanganyika Lake is rising so rapidly that in a few years the waters of the Lukuga and the Luindi will unite, the intervening marsh disappear, and a permanent outlet thus be created.

The Topographical Survey of New York. — The governor of New York having opposed the passage of a bill in the legislature of that State making appropriations for continuing the state geographical survey, begun so well by Mr. James T. Gardner, resolutions urging the passage of the bill have been sent in by the leading universities and colleges

of the State, and it will be a great pity if the public sentiment of the State is disregarded by its executive. A topographical survey of New York by one of the leading geographers of the country would be a model for other states to follow.

MICROSCOPY.[1]

A Foreign View of American Microscopy. — Mr. Henry Crouch, the well and favorably known London optician of that name, who spent a considerable part of last summer at Philadelphia in the double capacity of a British commissioner and an exhibitor, improved the opportunity to become acquainted with many of our microscopists, and to study the various styles of instruments exhibited at the Centennial. His contribution on the subject, addressed to the Queckett Club after his return home, is of more than ordinary interest on account of his special and technical knowledge of the subject, his position as a fellow exhibitor, to which he candidly alludes as a peculiar feature in the case though not a motive to control his statements, his comparative independence of local sympathies and prejudices, and his evident feeling of good will and cordiality towards those whom he met while here. He heartily acknowledges the hospitable treatment received in this country, and intimates that a vacation spent here is a rare pleasure, a statement which elicited from the president of the club a hearty assurance of reciprocation in case any of our microscopists should visit London.

Mr. Crouch mentions with pleasure and surprise the interest and promptness with which the progress of microscopy in England is followed up in this country. He notices the large number of students of diatoms, due, he suggests, to the great abundance of the fossil deposits here, and the comparative unfamiliarity with other forms of pond life. He regrets, as we do, the absence from the circle of exhibitors of some eminent competitors for success in the same department of manufacture.[2]

The very general adoption of the Jackson form of stand in this country, which has always been a fact, Mr. Crouch regards as an encouraging confirmation of his uniform belief and practice; the continental model being used, as far as he noticed, only by those who employ the microscope in some narrow specialty, and for the most part without accessories. The same remarks would apply to the binocular, and they are certainly correct if the specialties be understood to include histology and pathology, for which many of the English and American accessories are not needed, or at least not popular. As further peculiarities of the

[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

[2] The opinion having been expressed in the Naturalist, December, 1876, page 730, that the insinuation that Tolles' lenses were not exhibited at Philadelphia because they would not be properly examined there, must have been authorized without serious thought, Mr. Stodder desires the correction made that the reason given for withholding the lenses was not intended to be insinuated but distinctly stated in the case referred to, that it was adopted after mature consideration, and that he still considers it justifiable and proper.

American stands, he notices the greater prevalence than in England of stands having the limb supported by one pillar instead of two, though what happened to come before his notice gave a greatly exaggerated idea of the proportion of single-pillar instruments used here, the more general use of the [Zentmayer] glass stage, the general absence of a concentric stage rotation, except in the larger stands, the hinging of the mirror-stem for better managing oblique light, and the new plan of swinging mirror and substage together as now made by both Zentmayer and Gundlach. He mentions Zentmayer's new portable microscope very favorably, along with one by Ross, and claims the centring adjustment now used on the best stands as his own, though contested by two claimants here.

Of objectives he with very good taste hesitates to speak comparatively, adding a good-natured allusion to the well-known sensitiveness on this subject of makers, and the peculiar weakness of each for considering his own unquestionably the best in some important particulars. Subsequent discussion, however, drew out the opinion that the work of some American opticians was very good, and differed from others (abroad) only in some few peculiarities. He had seen some of Mr. Tolles' objectives which he had not found equaled elsewhere, though his impression was that he pushed the angle of aperture too far, and sometimes to the positive detriment of his lenses. Microscopes of the better class he believed were produced in America fully as good as in England, though at far higher prices. Micro-photography he finds more extensively cultivated here than at home, with an evident influence on the construction of objectives, especially in regard to the angular aperture of the higher powers, the advantage of which he thinks is at least questionable, and from his own recent observations he is inclined to believe that "there are other and important directions in which the energies of those engaged in the manufacture of objectives can be more profitably employed."

He finds the accessories exhibited of the usual character, and not calling for special remark, though he states that he has had "the pleasure of receiving many valuable hints respecting the improvement and modification of some of the accessories from Dr. Woodward, of Washington, Dr. J. G. Hunt and Mr. Holman, of Philadelphia, Dr. Ward, of Troy, and other microscopists," which he hopes to have an opportunity of carrying out and submitting to further notice.

The mounted objects by Mr. Walmsley, of Philadelphia, Dr. Beattie, of Baltimore, and Dr. J. G. Hunt, of Philadelphia are mentioned with praise; the vegetable preparations, transparent and double stained, by the latter person are regarded with evident enthusiasm as remarkable illustrations of vegetable structure mounted in an unsurpassed manner. Dr. Hunt's exquisite transparent vegetable preparations can hardly be better appreciated anywhere than here, but that they should now be regarded as novelties is almost incredible. When first produced many years

ago they were believed to be a large and important contribution to the progress of microscopy, but the methods worked out by Dr. Hunt were so unselfishly communicated, and the objects so liberally distributed and so largely studied and imitated, that they have long since become common property. Even the addition of double (vegetable) staining, systematized and rendered practically successful through the talented labors of Dr. Hunt and Dr. Beattie, is no longer spoken of as a novelty here.

In comparison, if not in contrast, with these criticisms by a practical foreign artisan may be noticed a critical paper on the same subject by a leading American botanist and philosophical microscopist, Dr. J. G. Hunt, just published in the *Cincinnati Medical News*. Dr. Hunt discusses American as compared with foreign microscopes at the Centennial.

The new Ross stands he considers superior to the old form in improved appearance, greater accuracy of motion, more steadiness with less clumsiness, and a binocular prism not moved by focusing, but the stage is considered still too thick, the change of power during fine adjustment a perceptible fault, and the finish only moderately good. Beck's large stand is considered the best of foreign make in form and finish, though defective in lacking centring adjustments to the rotating stage (which we think were added to some of the stands exhibited at the Centennial), and in want of durability in the stage movements. The stands by Mr. Crouch are considered excellent and durable, and successfully cheapened without sacrificing commercial good work. His claim of the adjustable concentric stage is denied in favor of Zentmayer who introduced it sixteen years ago. [Mr. Zentmayer undoubtedly introduced this adjustment long ago with a screw-driver movement, which he still prefers, while Mr. Crouch has more recently added milled heads so that it can be moved without tools.]

The Nachet stands are considered neither elegant, convenient, nor durable, and the Hartnack instruments, not exhibited, are rated as clever working instruments in a restricted way, but inferior to the English and American.

German instruments are not esteemed, and are scarcely considered instruments of precision at all.

Of American stands only Zentmayer's are specially discussed, and these are judged to be preëminent, being the best microscopical work on exhibition, and having no superiors anywhere. His "American Centennial" stand is considered superior in workmanship and design to any others in the exhibition or elsewhere.[1] The hinging of the bar which carries all the illuminating apparatus, including the mirror, at the level of the object on the stage so as to revolve around that object, is credited exclusively to Zentmayer, and stated to have been wanting in the Rochester

[1] The principal novelties introduced in the construction of this stand have been already specified in the NATURALIST. We heartily concur with Dr. Hunt that this is the best first-class stand yet produced in the world.

instruments exhibited at the *opening* of the exhibition. [It was certainly present in the Rochester instruments exhibited during the summer.] This would give the priority in this important improvement clearly to Mr. Zentmayer.

The so called student's stands are mentioned with the intimation that too many of them are unfit for use, and with an earnest appeal for better workmanship in their construction.

Objectives are discussed without restriction to those exhibited at Philadelphia. Indeed it would be hardly possible to say anything comprehensive about them otherwise, since Mr. Tolles' work could not be overlooked in such a discussion.

Mr. Wenham's patent lenses, in which corrections are obtained by a single flint lens, were considered to give great promise, but to be so unsuccessfully mounted as to compel a suspension of judgment in regard to them. Mr. Crouch's lenses were considered excellent and exceedingly fine for their cost, though without extraordinary optical qualities, strikingly resembling in corrections the Wenham lenses. Beck's lenses retain their character for excellent optical properties, being as nearly achromatic as possible without aiming at maximum angle. Their mounting, however, is poor in design and execution. The new Powell and Lealand one-eighth ranks highest of all foreign objectives yet seen, and marks a new era in English microscopy. It gives a bluish-green light, with sharp and accurate definition, and a good image to the edge of the field. The mounting is superb, and the American [Tolles'] plan of traversing the back combination is adopted.

The German objectives are not commended, the lower powers being judged unfit for use, and the high ones to fail in comparison with our lower powers. The brass work is considered inferior, and the lenses show a want of finger skill.

Of American lenses he speaks chiefly of those by Mr. Tolles, because those of other makers have disappointed him. He considers that there are greater optical possibilities in Mr. Tolles, in the construction of lenses for the microscope, than in any other maker. His lenses are often thought faulty because not understood. No two of them are alike, but this is due, he is satisfied, not to unequal execution, but to a special change in each case to obtain a higher degree of some particularly desired quality. Neither are penetration and resolution incompatible to the extent claimed by the theorists. Some of Mr. Tolles' lenses of extreme angle have a penetration so extraordinary that they form the best lenses known for histological work by central light, showing details with a brilliancy not otherwise seen. A recent Tolles one-tenth has the same power as the new Powell and Lealand one-eighth, but with clearer and more brilliant definition and greater penetration. It adopts the [Wales'] method of adjusting for wet and dry by the screw-collar, while the one-eighth has a separate front, a less convenient plan.

Dr. Hunt fears that micro-photography, especially that whose best results are obtained by oblique light, may temporarily retard the best construction of lenses for histological work which is not proven to be best accomplished by lenses specially corrected for obliquity. He thinks that our best lenses have optical capacities not yet fully developed, and that improvement in illuminating apparatus, particularly that for obtaining accurate central illumination, modified or concentrated at will, is more needed at present than further improvement in lenses.

Of microscopical objects he believes that the best work is always kept at home, and that with few exceptions we receive from Europe only what is unsalable there. The finest pathological work he has seen, at least that retaining the most structural details if not the most neatly mounted, was produced at the Army Medical Museum at Washington. In demonstrating and mounting botanical subjects, he considers this country immeasurably in advance of all others. He does not state (what should be stated) that this advance is very largely due to his own distinguished labors. Biological science, however, is not satisfied with microscopical slides, but turns to the living objects for a knowledge of structural details, and even the mounted preparations of the present and the future must show the whole structure of the cell, and not its empty shell, however beautifully displayed.

Obituary. — Died at Boston, Mass., on Monday, March 19th, Edwin Bicknell, one of the most genial of men and one of the most skillful of workers with the microscope. Outside the circle of his personal friends, among whom he was conspicuous for his cordiality and hearty good will, he was best known and will be longest remembered for his highly successful work in the preparation of microscopic objects. His slides, especially those of hard sections, have scarcely been equaled by any other maker. The exquisite slides which he sent out some years ago, by an arrangement with the Essex Institute of Salem, Mass., under the name of the Essex Institute Microscopical Works, have been followed ever since by an unbroken succession of excellent work.

SCIENTIFIC NEWS.

— From a recent letter from Dr. L. de Koninck, of Liége, Belgium, to Professor Hayden, we learn that the king of Belgium last year proposed a prize of twenty-five thousand francs to be awarded annually to the best memoir on the history of the country, its relations to foreign countries, sciences, etc., which prize even foreigners are allowed to compete for at certain periods on specific subjects. The king has also initiated an important movement toward the exploration of Africa. The subscriptions for this purpose are already quite large, and inspire the hope that strong aid can be given to the brave men who desire to devote

themselves to the emancipation of the negroes in their own country and thus destroy the last vestiges of slavery.

The Geographical Society, which has just been established under the presidency of General Liagre, perpetual secretary of the Academy of Brussels, is progressing finely.

The Belgian government has ordered the issue of a new edition of Dumont's Geological Maps. The House has appropriated 9700 francs for the purpose of collecting the necessary materials for a map on a large scale, $\frac{1}{1000}$, the entire cost of which will be 1,300,000 francs; it is to be completed in fifteen years. The House has made an additional appropriation of 10,000 francs for the publication of the manuscripts left by Dumont, which will be printed the coming year.

A still more important movement for the advancement of science has just taken place in the creation of the Annals of Natural History of the Museum of Brussels. These Annals will be published in large quarto volumes containing many plates in quarto or folio, according to the subjects, and are especially intended to inform the learned public of the scientific wealth of the galleries of the museum. The first volume will be devoted to the description of the rich collections of the fossil remains of the cetaceans and other sea mammals, gathered at Antwerp during the work on the fortifications. This volume, of which eighteen plates folio are already finished, will be written by the learned zoologist, J. van Beneden. The second volume will be prepared by Dr. de Koninck, one of the most learned palæontologists in Europe, and will embrace the Carboniferous fossils of Belgium, forming a series of 1000 to 1200 species, all of which will be described and figured within three or four years, provided the health and vigor of the distinguished savant does not fail him.

The third volume, by Dr. H. Nyst, will treat of the Tertiary fossils of Belgium, beginning with the most recent ones, as the Crag. of Antwerp. Several plates for this volume are already finished. Other volumes of no less importance are in a state of preparation and will occupy their proper places in the series. These publications will be prepared at the expense of the government and under the direction of M. E. Dupont, director of the museum, their authors, however, being entirely independent as to their opinions and work. In closing his letter Dr. de Koninck remarks with commendable pride: "On glancing at the preceding you will be satisfied that our country, after remaining almost stationary, for a period of twenty years, has taken a decidedly fresh start in scientific matters, aided and favored by our government, our Chambers, and especially by our king. Let it be well understood that besides all this we possess not only the Academy, but also a certain number of scientific societies, namely, the Royal Society of Sciences, Liége; the Entomological and Malacological societies, of Brussels; the Society of Science, of Hainault; the Association of Engineers, of Liége, and many other

less important ones, which, however, have a legitimate existence. You see we have not much reason to complain of the sacrifices of our government, which though considerable, cannot equal those we impose on ourselves with regard to the resources we dispose of. Therefore, please send us, to facilitate our researches and to lend us strength and courage, all the publications you can spare. Help by keeping us constantly advised of the scientific progress of your country, and we promise to reciprocate. You will receive very soon the products of our scientific activity. This will be a fair exchange of thought no fiscal law can prevent and which surely will benefit both progress and humanity." — F. V. H.

— The council of the Geological Society of London have awarded the Bigsby medal to Prof. O. C. Marsh, of Yale College, in recognition of the great services which he has rendered to the palæontology of the vertebrata.

— We are glad to announce that Dr. Elliott Coues has kindly consented to edit the department of Vertebrate Zoölogy of the AMERICAN NATURALIST, with especial reference to ornithology. Our readers may expect from this talented and genial naturalist occasional papers as well as items of ornithological news.

SCIENTIFIC SERIALS.[1]

MONTHLY MICROSCOPICAL JOURNAL. — March. Address of the President, H. C. Sorby (Application of the Microscope to Geology). Measurements of Rulings on Glass, by E. W. Morley.

THE GEOLOGICAL MAGAZINE. — March. Evidence afforded by the Planet Mars on the Subject of Glacial Periods, by Edward Carpenter. A Permian Fauna associated with a Carboniferous Flora in the Uppermost Portion of the Coal-Formation of Bohemia, by O. Feistmantel.

THE GEOGRAPHICAL MAGAZINE. — March. Communication with Siberia by Sea, by J. Wiggins (with map of Kara Sea). The Works on the Tiber. Topographical Surveys in Asiatic Russia during 1875 by M. Venyukof. Champa. The Nile from Mruli to Dufli (with a map of the Upper Nile from surveys made by General Gordon Pasha, by E. G. Ravenstein).

CANADIAN ENTOMOLOGIST. — January and February. History of *Phyciodes Tharos*, a Polymorphic Butterfly. (*Marcia*, winter form of *Tharos*.)

PSYCHE. — No. 32. Bibliographical Record of Papers on American Entomology (continued in each number).

[1] The articles enumerated under this head will be for the most part selected.